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THE WORLDWIDE TECHNOLOGY WEEKLY
AUGUST 19, 1985

PICTURE PHONES GET A NEW IMAGE

TODAY'S TECHNOLOGY BRIGHTENS INTEREST
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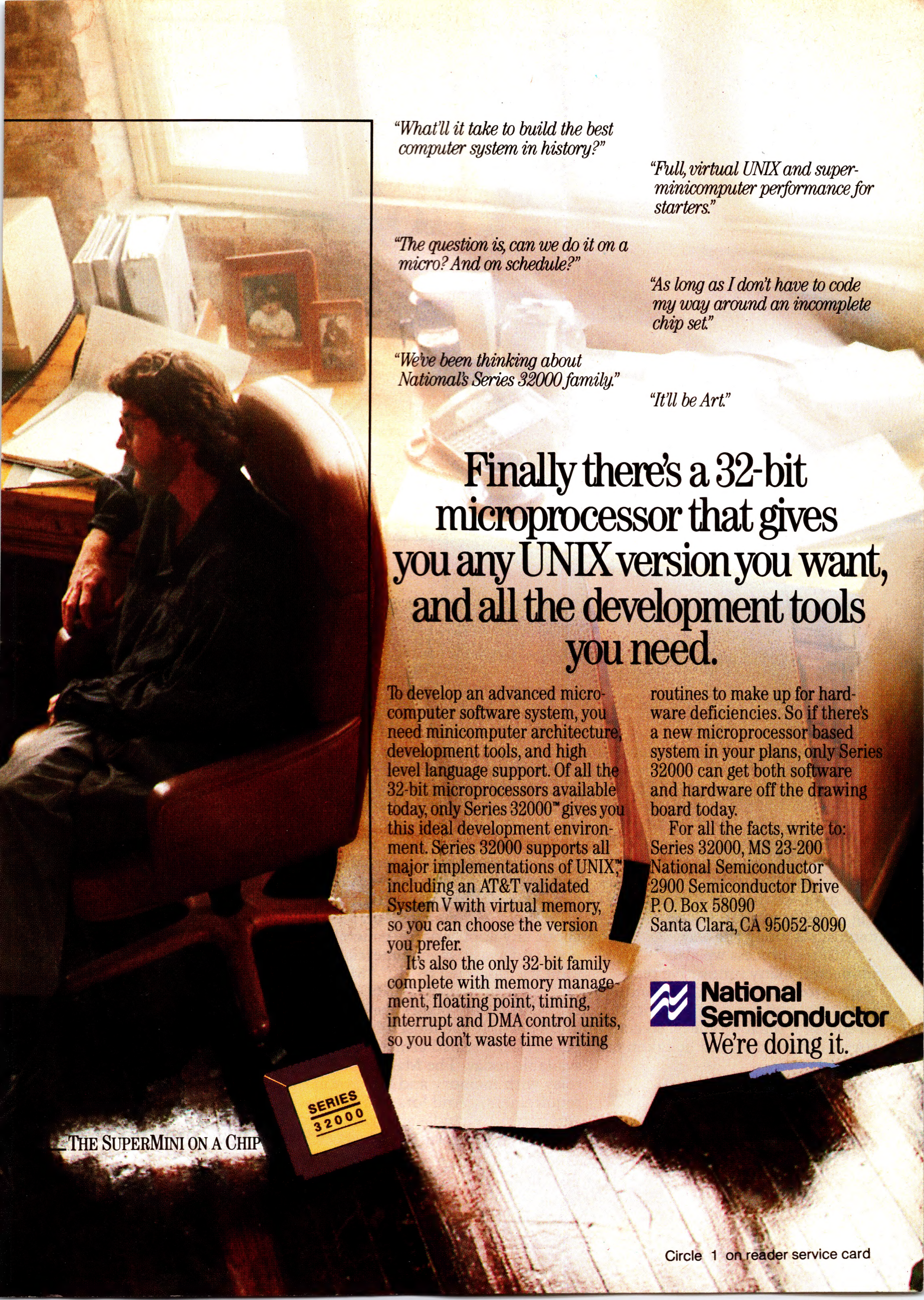
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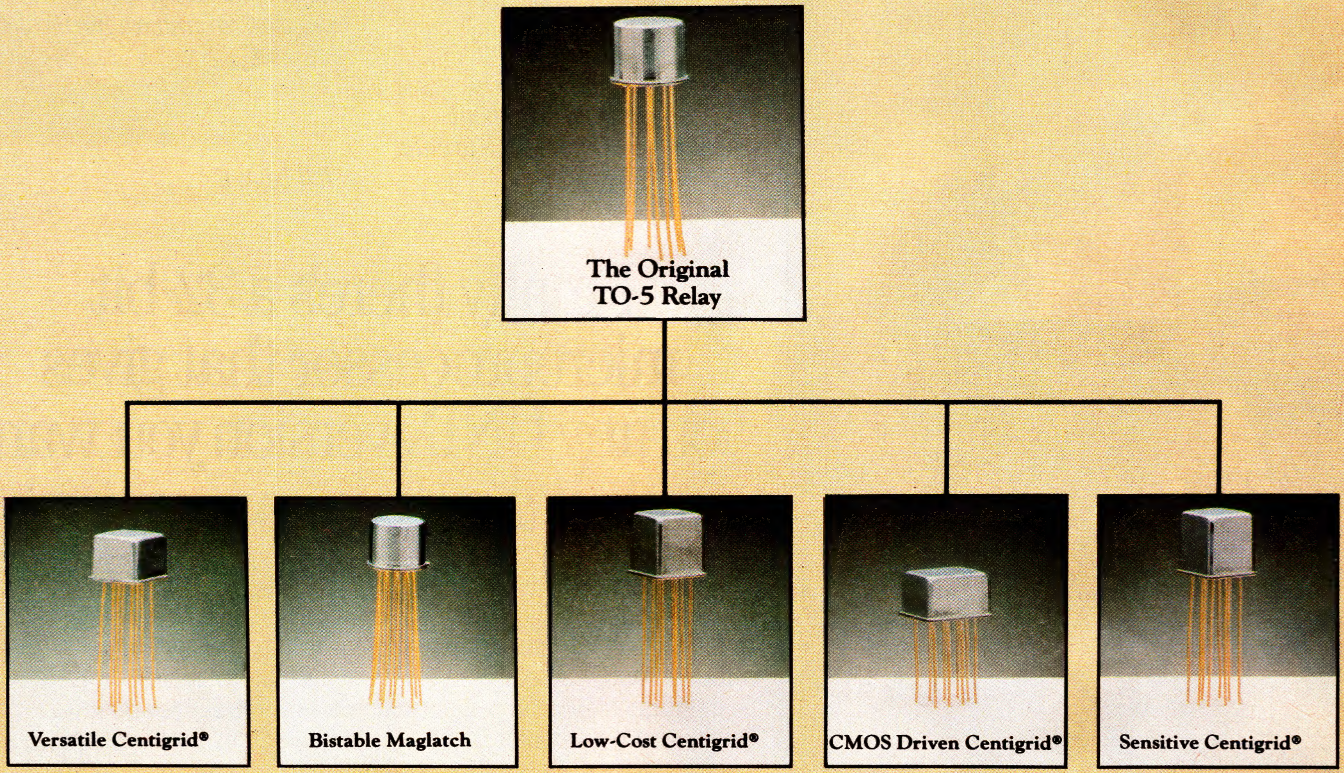

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PUBLISHER'S LETTER

When *Electronics* began appearing every week a little more than a year ago, one of the most exciting prospects for the writers and editors was the opportunity to bring you more timely and comprehensive information. In this week's issue, we are making two changes that take advantage of that opportunity.

One is the addition of Products Newsletter, which will provide early insight into what's coming, or about to come, onto the market. This page will be one of the last to go to press so that we can report on the latest products. The other change is the refocusing of the page that we call This Electronics Week, which will permit us to round up more of the week's industry and technology news in one place than was possible in the former diary format for a more comprehensive package.

The first telephone was introduced well over 100 years ago. But as the battery of reports in this issue demonstrates, it is still evolving, and there is plenty of room for innovation and excitement—in the resurrected picturephone business, for instance (see stories beginning on p. 30).

As Bob Rosenberg, who wrote the Technology to Watch on p. 34, points out, some sense of that excitement is conveyed by the fact that four *Electronics* editors—who, with at least 100 years of industry watching among them, are not easily impressed—crowded into a demonstration of Image Data Corp.'s frame-grabbing teleconferencing Photophone with founder Gerard Cullen.

But Image Data is just one player in a crowded field and Cullen is taking just one approach. Says Wesley Iversen, our Chicago bureau manager and author of the Probing the News on p. 30 that tells the story of the companies that are active in the reborn industry and their technology: "The people who are developing 56-kb/s video codecs aimed at full-motion picture phones are a pretty innovative bunch. And like all entrepreneurs, they are dedicated. For example, Widcom founder Bob Widegren took out eight mortgages on his house to get the company started. At Avelex, the founders are several former Navy researchers who worked in a basement lab for five years without pay while developing their algorithm."

Both Widcom and Avelex were put together by individuals with a lot of experience. But there is also some bright young talent making the industry an exciting place to be. Two of those people are at Pictel, where the brains behind the company's Motion Compensation Compression algorithm are two 23-year-olds—Brian Hinman and Jeffrey Bernstein. Friends since childhood, the pair had long dreamed of starting a business. They saw their opportunity when they both got interested in low-bit-rate digital coding while doing graduate work in video research at the Massachusetts Institute of Technology.

"You never know," says Wes. "But Pictel's president, Ron Posner, compares them and the company to Apple Computer and its founders, Steve Jobs and Steve Wozniak, who were pioneers of a new industry."

Laurence Altman

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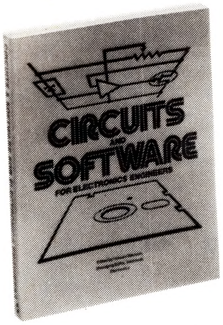

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Esscirc '85: 11th European Solid-State Circuits Conference, French National Center for Scientific Research *et al.* (J. P. Bailbe, 7, Ave. du Colonel-Roche, 31077 Toulouse, Cedex, France), Scientific University of Toulouse, Toulouse, Sept. 16-18.

Semicon/East '85, Semiconductor Equipment and Materials Institute Inc. (625 Ellis St., Suite 212, Mountain View, Calif. 94043), Bayside Exposition Center, Boston, Sept. 17-19.

Videotex Europe—Basel '85, International Videotex Industry Association (Sekretariat Vtx 85, Swiss Industries Fair, Postfach CH-4021, Basel, Switzerland), European World Trade and Convention Center, Basel, Sept. 17-19.

Unix Expo, National Expositions Co. (Robert P. Birkfeld, National Expositions, 14 W. 40th St., New York, N. Y. 10018), New York Hilton and Sheraton Centre, New York, Sept. 18-20.

MCSC '85: Mobile Communications Show and Conference, EIA (Jack Wayman, EIA, 2001 Eye St., N. W., Washington, D. C. 20006), Convention Center, Washington, Sept. 26-28.

11th Industrial Innovation Conference, American Association of Small Research Companies (1200 Lincoln Ave., Suite 5, Prospect Park, Pa. 19075), Hyatt Regency, Columbus, Ohio, Oct. 1-3.

Electronicom '85: International Electrical, Electronics Conference and Exposition, Canadian Region of the IEEE (Don Gerrior, CRIEEE, 1450 Don Mills Rd., Ontario M3B 2X7, Canada), Metro Toronto Convention Centre, Toronto, Oct. 7-9.

ICCD '85: International Conference on Computer Design, IEEE (ICCD '85, P. O. Box 639, Silver Spring, Md. 20901), Rye Town Hilton, Port Chester, N. Y., Oct. 7-10.

CEPS: Corporate Electronic Publishing Systems Conference and Showcase, Interconsult Inc. (Cahners Exposition Group, 999 Summer St., Stamford, Conn. 06905), Sheraton Centre, New York, Oct. 14-16.

INFO '85, Cahners Exposition Group (CEG Client Services, 999 Summer St., Stamford, Conn. 06905), New York Coliseum, New York, Oct. 14-17.

Power Electronics Design Conference, Power Sources Conference Inc. (Power Electronics Design Conference, 17100 Norwalk Blvd. Suite 116, Cerritos, Calif. 90701-2750), Marriott Hotel and Inn-At-The-Park, Anaheim, Calif., Oct. 15-17.

Topical Meeting on Optical Data Storage, IEEE *et al.* (Optical Society of America, 1816 Jefferson Place, N. W., Washington, D. C. 20036), Washington Hilton, Washington, Oct. 15-17.

Real-Time Processing: Application in Control and Signal Processing, Swiss Federal Institute of Technology-Lausanne (Secretariat of Journées d'électronique, EPFL, Chemin de Bellerive 16, CH-1007 Lausanne, Switzerland), Swiss Federal Institute of Technology, Lausanne, Oct. 15-17.

ADEE East '85: Automated Design and Engineering for Electronics Exposition and Conference, Cahners Exposition Group (Cahners Plaza, 1350 E. Touhy Ave., Des Plaines, Ill. 60018), Bayside Exposition Center, Boston, Oct. 15-17.

CMC '85 and A/E Systems—Fall, Fleishman Communications Inc. (Conference Director, CMC '85 and A/E Systems—Fall, P. O. Box 11318, Newington, Conn. 06111), Albert Thomas Convention Center, Houston, Oct. 15-18.

Fall Meeting of the Power Conversion Products Council International, PCPCI (Betsy Bevington, PCPCI, P. O. Box 637, Libertyville, Ill. 60048), Broadmoor, Colorado Springs, Oct. 16-18.

International Trade Fair for Industrial Electronics, Arbeitsgemeinschaft für Fachausstellungen Gesellschaft mbH (Arge, Loquaiplatz 13, A-1060, Austria), Trade Fair Grounds, Vienna, Austria, Oct. 16-19.

Itame: International Test and Measurement Exhibition & Conference (British Information Services, 845 Third Ave., New York, N. Y. 10022), Olympia, London, Oct. 20-Nov. 2.

Hammer Forum '85: Shaping the Second Revolution in End-User Computing (Hammer & Co., 5 Cambridge Ctr., Cambridge, Mass. 02142), Westin Hotel, Boston, Oct. 21-23.

5th IEPS Conference, International Electronics Packaging Society (P. O. Box 333, Glen Ellyn, Ill. 60137), Marriott Hotel, Orlando, Fla., Oct. 21-23.

CEIDP: Conference on Electrical Insulation and Dielectric Phenomena, IEEE (Steven Boggs, Ontario Hydro Research, 800 Kipling Ave., Toronto, Canada M8Z 5S4), Marriott Hotel, Amherst, N. Y., Oct 21-24.

Infomatics '85, International Information Management Congress (P. O. Box 34404, Bethesda, Md. 20817), RAI Center, Amsterdam, Holland, Oct. 21-24.

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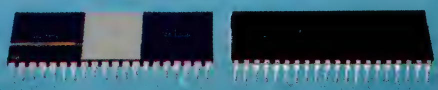

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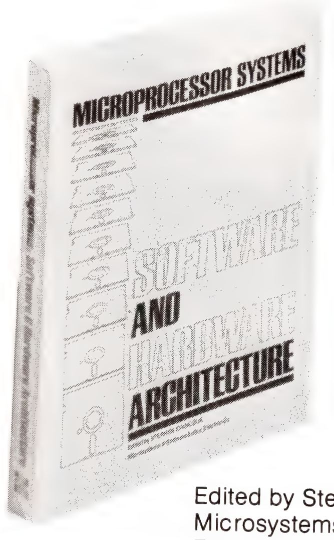

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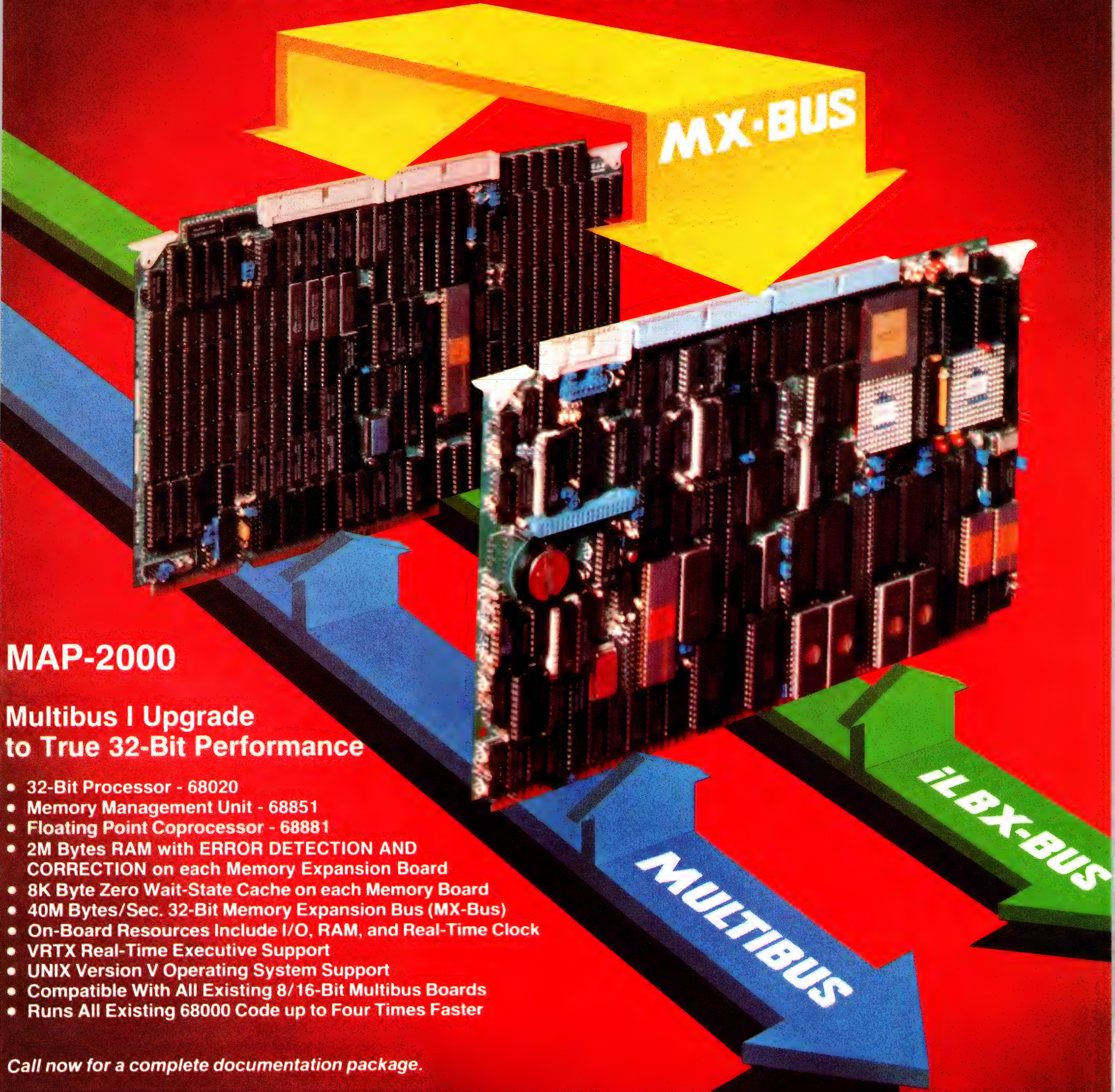

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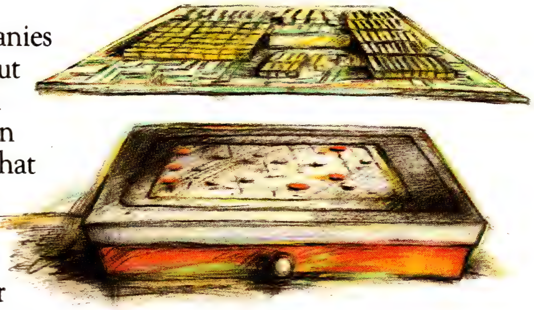

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ELECTRONICS NEWSLETTER

U. S. EXPECTED TO BLOCK SALE OF FRENCH NETWORK TO CHINA

French electronics-industry executives and government officials are fuming over an expected move by the U. S. government to keep one of France's largest computer software and engineering companies from gaining a foothold in the lucrative Chinese market. At an upcoming meeting of the Paris-based Coordinating Committee (Cocom), the U. S. government is expected to veto the sale of an advanced packet-switching network to China by the Société d'Etudes des Systèmes d'Automation. Cocom approval is required for all sales of advanced technology from member countries—Japan and all North Atlantic Treaty Organization countries except Iceland—to communist nations (see related story, p. 26). SESA says the network is to be used for business communications for the cities of Beijing and Shanghai, but the U. S. objects to its sale on the grounds that the system could be used for military purposes. SESA won the order in December of last year against stiff competition from ITT Corp. of the U. S. and Canada's Northern Telecom. ☐

SIA LOWERS MARKET ESTIMATE AGAIN BUT SEES A RAY OF HOPE

The Semiconductor Industry Association again lowered its U. S. market estimate for 1985 based on the July dive in bookings and billings, but offers some hope for an upturn. Billings were $584.6 million, down 19.4% from June; average bookings for the three-month period ending in July were $475.8 million, down 6.1% from June and 57.8% from the same period in 1984. The book-to-bill ratio remained at 0.72, the same as the June figure. With the new figures, the SIA now predicts 1985 sales of about $8.7 billion, down 25% from 1984.

SIA statistician Mike Kubiak offers this mildly hopeful note: "All indications are that things won't be any worse in August. We look for an upturn in September. If we are to have any [substantial] shipments in the fourth quarter, the orders have to start then." ☐

WESTINGHOUSE TO STUDY BLIMP-BORNE RADAR

Westinghouse Defense and Electronics Systems Co. (Syscom), Baltimore, will study the feasibility of the U. S. Navy using very large airships to deploy radar for extended periods. In one study for the Naval Air Development Center, Westinghouse and Airship Industries of London will formulate concepts for using blimps to carry primary surveillance radars and other stationary mission equipment. Such a system would provide surface vessels with real-time information on the location, movement, and identification of air, surface, and underwater targets. Westinghouse's contract is valued at $650,000. A second contract, worth $300,000, is intended to develop an airborne multimode radar system to serve as the primary sensor for the Naval Airship System. Westinghouse expects to complete the studies by year end. ☐

HP WILL PHASE OUT ANALOG OSCILLOSCOPES

Customer enthusiasm for digital oscilloscopes is prompting Hewlett-Packard Co. to phase out its entire line of analog oscilloscopes by the end of 1986 and replace them with digitizing scopes. Murray Haynes, oscilloscope product manager for HP's Design Systems Group in Colorado Springs, claims the company's most recent digitizing scopes, the Model 54100A/D and 54200A/D, "took off two times faster than we expected." Because of their popularity, he says, only two analog models will be offered next year. Haynes claims that customers are willing to pay the heftier price—up to six times the price of an analog oscilloscope—for a digital scope's extra processing and programming ability. ☐

ELECTRONICS NEWSLETTER

BRITAIN AND FRANCE TEAM UP TO CUT SUPERCOMPUTING COSTS

A collaborative project by four British and three French groups aims to cut the entry cost into supercomputing by adopting a parallel-processing approach instead of building a specialized machine. The project, funded by Esprit and guided by the UK's Southampton University, will be based on a large array of transputers, the Inmos International plc microprocessor designed to support parallel processing. Esprit, the European Strategic Program for Research in Information Technologies, will provide $6 million to build two machines. Each will have up to 400 transputers and an estimated performance of around 400 million floating-point operations/s. Extra processors can be added; in fact, the group's original proposal was for a 1,000-transputer machine, with an estimated performance of 1 billion flops. Project leaders estimate that such a system could be built for under $1.4 million, compared with $42 million for a commercial machine of similar performance.

Besides Southampton University, the British participants are the Royal Signals and Radar Establishment, Malvern; Inmos International; and its parent, Thorn EMI. The French contingent includes the University of Grenoble; the telecommunications-equipment manufacturer Telmat, based in Soults; and Apsis, a software company in Grenoble. ☐

REPORT SAYS BOOMING DSP MARKET WILL REVOLUTIONIZE SYSTEMS DESIGN

A revolution is in the making for systems design, based on the mushrooming world market for digital signal-processing integrated circuits, according to a study by consultants Mackintosh International Ltd. in Luton, England. Their study, with major electronics companies among the 30 clients, indicates the DSP IC market will grow from $187 million in 1985 to $1.7 billion in 1989 and then skyrocket to $6.8 billion in 1993. These chips will lead to big gains in systems' reliability and cost, says the report, but the changeover from more traditional designs means that engineers will have to be trained in new software skills and companies will have to invest in equipment to support specific DSP products. ☐

HUGHES CASE MAY SIGNAL U. S. CRACKDOWN ON PURCHASING ABUSES

Prosecutions of other military contractors may follow last week's heavy sentencing of two more Hughes Aircraft Co. buyers convicted of bribery. At the Los Angeles trial, U. S. District Court Judge Robert M. Takasugi sentenced Richard G. Moretine to one year and a day in prison and fined him $7,500; Michael J. Johnston received a nine-month sentence and a $2,500 fine. Both men, who will also be on probation for five years after completing their sentences, pleaded guilty to taking kickbacks on contracts from an outside contractor. Four of the ten defendants convicted in the Hughes bribery and kickback ring have now been sentenced. Investigators hinted at the trials that bribery and kickbacks are widespread throughout the industry, triggering speculation that a crackdown on purchasing abuses is on the way. ☐

WEST GERMANY MOUNTS EFFORT TO SEIZE 10% OF WORLD GaAs MARKET

Acknowledging that the U. S. and Japan have a two-year lead in gallium-arsenide technology, West Germany's Ministry for Research and Technology will launch a $40 million research and development program early next year. The aim is to help the country's semiconductor producers capture a 10% share of the world's GaAs market by the end of this decade. The program, to run four to five years, is designed to coordinate the activities at semiconductor companies and universities under the direction of the Fraunhofer Institute for Applied Solid State Research. ☐

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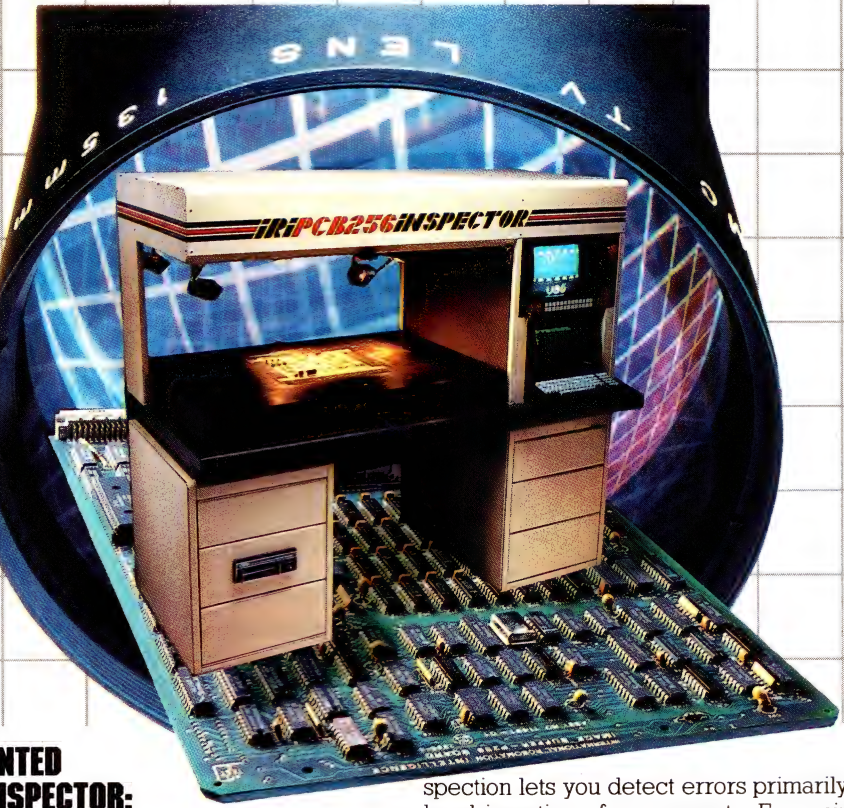

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Electronics

INTEL PUSHES LITHOGRAPHY TO 1 MICRON FOR MEGABIT DRAM

PART MAY SIGNAL REENTRY INTO COMMODITY MARKET

PORTLAND, ORE.

Intel Corp. has fabricated a highly competitive 1-Mb dynamic random-access memory based on CHMOS, its high-performance, 1-μm single-metal-layer CMOS process. Though it had ceded the market for commodity DRAMs to the Japanese at the 16-K level, the Santa Clara, Calif., company is now considering reentering the commodity market, probably at the megabit level.

Third-party fabrication arrangements with Asian integrated-circuit makers are also under consideration: a low-cost commodity version of the 1-Mb DRAM might be made in Korea.

Intel has chosen to take well-understood processing techniques and stretch them to the limit, says Sunlin Chou, director of technology development in Portland. Thus the DRAM, organized as 256-K by 4 bits, does not employ such unusual and untested techniques as trench-type isolation, certain storage-capacitor dielectrics, low-resistance gates, three layers of polysilicon, two metal layers, and self-aligning contacts.

Walking the line between the esoteric processing techniques of many U. S. companies and the experimental submicron lithographic techniques used by the Japanese, Intel's 1-Mb CMOS DRAM has a chip size of about 82,000 mils^2 and an access time of 80 ns, maximum (65 ns, typical). Memory-cell size is 28.5 μm^2 and capacitor size is 40 femtofarads.

This places it midway between the larger and slower circuits from companies such as Advanced Micro Devices, Mostek, Mitsubishi, Toshiba, and Texas Instruments and smaller and faster circuits from Hitachi and NEC.

Chou says Intel uses a sandwich of tungsten disilicide and poly instead of a second metal layer. "In addition to the fact that this is an approach we have much experience with, this interconnect scheme is much simpler and more efficient in terms of memory layout."

And instead of using a complex trench-isolation scheme that requires sloped silicon etching, Intel engineers have used a direct nitride sealing to reduce "bird's beak" growth to no more than 0.2 μm in the storage area. A storage-area efficiency of about 30% has been achieved, says Chou.

Most makers of CMOS 1-Mb DRAMs use an array of standard n-channel devices located in an isolated p-well. Intel has reversed things, employing a p-channel memory array in an isolated n-well. To reduce the chronic latchup problem found in CMOS devices, says Chou, Intel makes use of a p– on p+ epitaxial substrate, combining it with a twin n- and p-well front end.

Developers avoided unusual and untested IC technologies

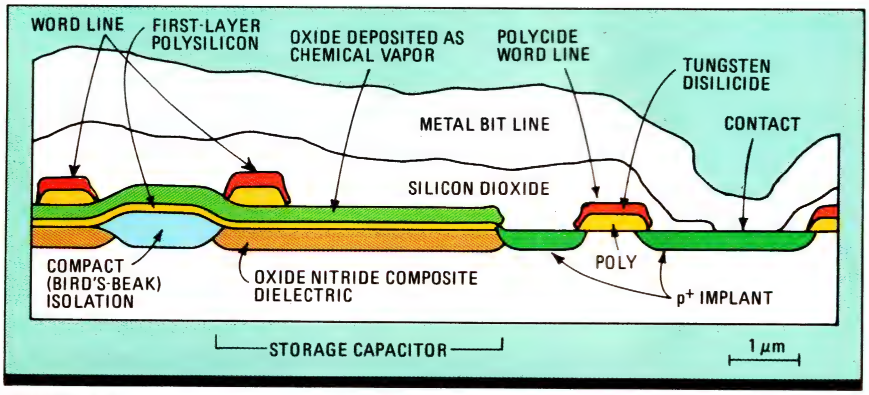
N-well CMOS arrays are better than the p-well approach, says Chou, because the substrate-bias effects of threshold voltages and the parasitic capacitances of the source and drain structures in both the p- and n-channel devices become lower. Moreover, the approach makes it easier to optimize the performance of the n- and p-channel transistors independently of one another. This allows scaling of the p-channel devices, where appropriate, down to the dimensions of the smaller n-channel structures. Minimum electrical channel lengths on both types are 0.8 μm. This approach also improves refresh performance by 10% to 15%.

NOVEL TECHNIQUE. If there is any "secret ingredient" in the mix of process techniques used to fabricate the Intel 1-Mb DRAM, it is the use of a novel technique for forming the metal-to-silicon bit-line contact and the glass surrounding that contact. The technique achieves a tight contact-to-gate-edge spacing using a relatively thick glass layer.

"In most designs, especially those employing glass layers, the contact-to-edge spacing is lost area," says Chou. "The technique we have developed eliminates much of this lost area." The company was unwilling to discuss the details of how it implements the technique.

According to memory products marketing manager Patrick Brooks, another factor has been critical to Intel's success with the fabrication of its 1-Mb DRAM: the aggressiveness with which it is pushing the state of the art in lithographic equipment. "Many of the 1-Mb DRAMs announced from such companies as AT&T, Mitsubishi, Toshiba, IBM, Fujitsu, and Mostek are designed with relatively loose design rules—comparatively speaking—in the range of 1.2 to 1.5 μm," says Brooks.

But Intel has taken a "multimillion-dollar gamble," he says, and invested in advanced lithographic equipment that will allow the company to move to submicron geometries as production experience and market conditions allow. "Much of this equipment is new and requires quite a bit of operational experience to produce high-resolution circuits with reliability and consistency," says Brooks. At Intel's R&D line in Oregon,



SMALL CELL. Intel has pushed standard lithographic techniques for its 1-Mb DRAM to make chips with 0.8-μm electrical channel lengths and a memory cell that takes up only 28.5 μm^2.

1-Mb DRAMs with 1-μm geometries are being produced with "acceptable yields and die size."

Brooks believes Intel's gamble will give it an edge on its competitors. "While they are still gaining the experience to move from 1.2 or 1.5 to 1-μm channel lengths, Intel will be moving to submicron geometries."

The company wants to work out third-party relationships with Asian manufacturers for production of various products, including its 1-Mb DRAM, executive vice president Jack Carsten has hinted. "The best way to describe our strategy is the old saying, 'The enemy of my enemy is my friend,' " he says.

"Rather than take on Japanese companies in the dynamic-RAM market directly, we believe the best approach is to make alliances with companies that, one, have the capacity; two, have the desire; three, have automated their production on a par with the Japanese; and four, have a low-enough labor cost," says Carsten. The big Korean IC firms are the only ones that meet these criteria, he says. "They are willing and able. Indeed, they are eager to get into it, toe to toe with the Japanese."

Though he did not rule out Intel's reentry into the commodity DRAM business, Carsten says that for now the company will confine itself to the high-performance end of the DRAM business. No firm decision will be made, says Carsten, until late 1986 or early 1987, when the 1-Mb DRAM moves to one of its production facilities in California, Arizona, or New Mexico. *–Bernard Cole*

INTERNATIONAL TRADE

JAPANESE CLAIM U. S. GETS FAIR SHAKE IN IC MARKET

SAN JOSE, CALIF.

The Electronics Industry Association of Japan is about to claim that U. S. companies have a far greater share of Japan's integrated-circuit market than official industry figures indicate. The Japanese response will come in a reply to be made this month to the U. S. Semiconductor Industry Association's complaint under Section 301 of the Trade Act of 1974 [*Electronics,* June 17, 1985, p. 13, and June 24, p. 23].

The SIA asserts that Japan's chip makers squeeze U. S. suppliers out of the Japanese market. In addition, the Japanese face a charge of dumping 64-K dynamic random-access memories and a Justice Department investigation of alleged predatory pricing by Hitachi Ltd. But a battle of numbers could be shaping up.

The U. S. has not been squeezed out of the Japanese market, claims Mamoru Tsukamoto, director of the Japan Electronics Bureau, New York, the EIA-J's U. S. arm. "It is premature to give figures, but I think that the American market share in Japan is higher than currently estimated by industry, almost comparable to Japan's share of the U. S. market."

Tsukamoto's estimate is modest compared with figures from Japan's Ministry of International Trade and Industry. MITI claims that U. S. companies already have more than twice the market share in Japan that Japanese suppliers command in the U. S. Its figures purport to show that U. S. companies account for 19.1% of a $5.35 billion Japanese IC market. It counts Japan's share of the U. S. market at only 9.1% of a market three times larger—$15.9 billion.

Figures assembled by the SIA-administered World Semiconductor Trade Statistics program show that last year Japanese chip suppliers accounted for 15.7% of a $9.7 billion U. S. market, whereas U. S. suppliers had only 12% of a $6.2 billion Japanese market (see table).

But the Japanese have recalculated markets in terms of trade flows among the U. S., Japan, and third-country operations. They have also added the large U. S. captive market to total IC sales when calculating market share. MITI claims that the SIA figures account for only about 85% of the merchant market.

MITI derives its captive-market figure of $4.615 billion from an estimate made by a market research company, Integrated Circuit Engineering Corp., Scottsdale, Ariz. IBM Corp. alone accounts for $3 billion of it.

The SIA does not include captive production because it never enters the market, and in some cases could not be sold on the open market because of special packaging. Tsukamoto says Japan incorporates figures for the internal sales of its large conglomerates. With respect to U. S. exports, he says, the SIA figures do not reflect sales from U. S. factories in Japan or from U. S. companies in offshore locations such as Singapore and Scotland.

SIA STANDS FIRM. The SIA flatly denies these assertions. "The Japanese industry is well aware that the data used by the SIA includes both of these categories," the association said in a statement.

In fact, says SIA president Thomas D. Hinkelman, the Japanese numbers "will never stand up under analysis. It's going to be embarrassing for them." The Japanese subscribe to the World Semiconductor Trade Statistics reporting procedures, and they themselves submitted the figures that they now challenge regarding the Japanese market, Hinkelman points out.

However the EIA-J responds formally to the Section 301 complaint, Hinkelman continues, the Japanese have already made informal overtures to resolve the trade dispute. The MITI figures, he maintains, amount to little more than a delaying tactic.

"Worrying about the numbers is unrealistic," says Ralph Thomson, senior vice president of the American Electronics Association. "The issue is economic policy. The U. S. electronics industry won't let the industrial electronics sector go the way of consumer electronics," he claims.

Thomson, who recently was in Japan, where he met with top industry and government officials, says he saw evidence that the Japanese are making sincere efforts to open up their markets to U. S. companies. Hitachi's promise to purchase $120 million in U. S.-made equipment and components [*Electronics,* Aug. 5, 1985, p. 12], is "not trivial," Thomson says, in that Hitachi will accept higher prices if necessary to meet its commitment.

Next month, the AEA and the EIA-J will hold an industrial summit meeting that will detail

U.S. AND JAPAN DISAGREE ON 1984 IC TRADE

	U.S. figures	Japanese figures
	($ millions)	
IC Sales in Japan		
Total market	6,177	5,350
Imports from U.S.	na	612
Imports from U.S. third-country operations	na	126
Sales in Japan by U.S.-owned plants	na	285
Total U.S. share	741	1,023
IC Sales in U.S.		
Total market	9,656	15,947
Imports from Japan	na	1,267
Imports from Japanese third-country operations	na	6
Sales in U.S. by Japanese-owned plants	na	246
Total Japanese share	1,519	1,519

SOURCES:
U.S. FIGURES: SEMICONDUCTOR INDUSTRY ASSOCIATION
JAPANESE FIGURES: MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY

other Japanese steps toward opening up its markets. Meanwhile, says Thomson, the revised semiconductor-market figures are an accounting practice that skews the issue. "Whatever the numbers, the economic realities are no longer politically sustainable," he says. Layoffs and losses for U. S. companies are making trade barriers and quotas a distinct possibility. *–Clifford Barney*

AEA PLOTS CHANGE IN TRADE BENEFITS

WASHINGTON

While electronics companies crusade to convert Japan into a free and open market, trade barriers have cropped up in countries from Mexico to Taiwan. The American Electronics Association wants Washington to nip this problem in the bud and has recommended a way to do it: expand GSP benefits for those who play by the rules and take them away from those who don't.

The GSP, for Generalized System of Preferences, is a trade and investment promotion program that allows developing countries to export goods to the U. S. duty free. To qualify, a product must have at least 35% domestic content and meet a competitive-need stipulation that exports of the product to the U. S. not exceed $63.7 million.

The AEA is proposing that the GSP be used as a carrot-and-stick mechanism to get governments to stop "bad" behavior. By bad, the AEA means the country is either failing to protect intellectual property or is maintaining serious barriers to U. S. investment and market penetration. In testimony submitted last month to the Office of the U. S. Trade Representative, which is charged with implementing GSP agreements, the AEA identified 10 "bad" countries (see "AEA cites countries for poor trade conduct").

The GSP wouldn't have the AEA on the move except for a little-known provision of the 1984 Trade and Tariff Act directing the President to determine whether a country is abiding by free-trade practices prior to awarding it GSP status. GSP benefits are up for review, with final decisions due by the end of 1986. "Today is the time to do it so we won't be facing mini-Japans 10 years from now," says William Krist, AEA director of international trade affairs.

CARROT FIRST. "For all cases, our first choice is to offer the carrot," says Krist. To get bad GSP countries to mend their ways, the AEA suggests the U. S. offer to waive or relax competitive-need ceilings. To encourage U. S. investment, the AEA wants a change in the local-content rule so that either U. S. or beneficiary-country content could be used to qualify for the 35% minimum.

Except for Brazil, all have exceeded competitive thresholds on a range of electronic products and want waivers for continued GSP privileges, reports Dave Shark, the Office of the Trade Representative's executive director of GSP programs. He sees three options: the limit could be waived, left alone, or reduced. But in considering a waiver "we are certainly going to ask our GSP friend what it's done lately to make itself a good international citizen."

"Obviously, it's no magic wand and it's not going to correct all of our trade problems," remarks Shark. If the U. S. told a country to change now or forget GSP, it would probably accept the loss, he concedes. But he does think GSP can be a useful lever to promote favorable developments. *–Karen Berney*

AEA CITES COUNTRIES FOR POOR TRADE CONDUCT

The American Electronics Association is urging Washington to strip a number of countries of their favored trade status under the General System of Preferences unless they indicate a willingness to reform. The AEA accuses 10 countries of trade transgressions ranging from import duties and bans to copyright infringements. Of these 10, Mexico, Brazil, South Korea, Taiwan, and Singapore attract particular attention because they represent 65% of U. S. imports under the GSP.

For example, the GSP applies to 15% of South Korea's $10 billion in exports to the U. S. The AEA says the country bans imports of microcomputers and minicomputers, imposes import duties as high as 40%, and is targeting the electronics industry by promoting technology transfer and discouraging equipment imports. Korea does not protect foreign copyrights and chip designs, even though it is on the verge of becoming a world-class semiconductor power.

About 20% of Taiwan's $16 billion in U. S. exports qualify for GSP. The Computer and Business Manufacturers Association charges that Taiwan flagrantly copies U. S. computer software and usually sells the resulting product for 1% of the U. S. list price. The AEA adds that trademark and patent laws are inadequate and enforcement is weak. Taipei imposes stiff tariffs and requires as much as 90% local content in some electronics products.

SOFTWARE

NEW FEATURES TUNE UNIX FOR HIGH-END MACHINES

DALLAS

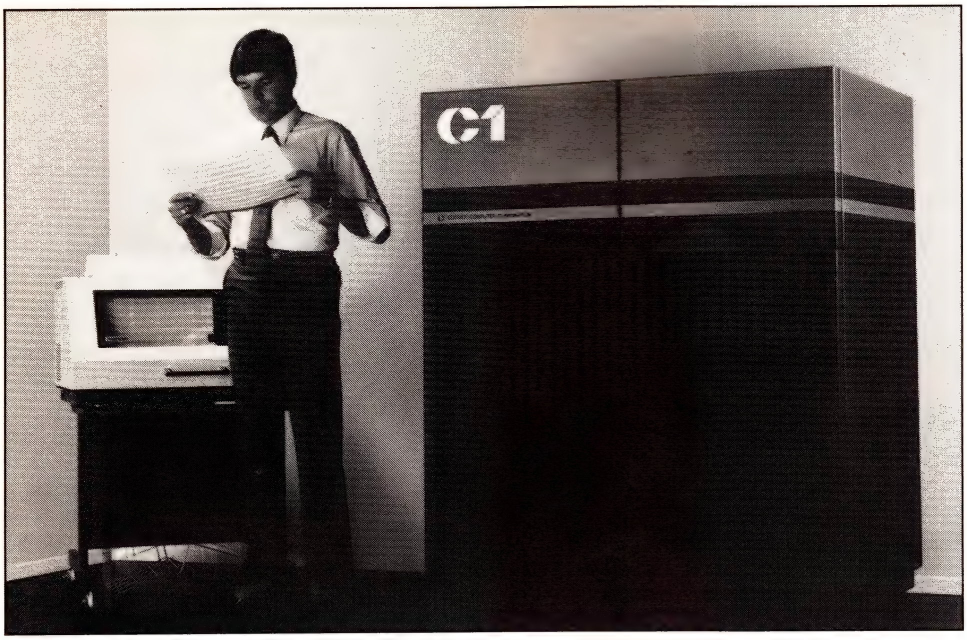
More powerful than a mainframe and able to break system bottlenecks with parallel operations, a new breed of Unix could shape up from efforts to adapt AT&T's popular operating system to new small supercomputers and multiprocessor hardware.

The metamorphosis of Unix is by no means certain in upper-end computing circles. But many software developers and industry observers believe the recent wave of Unix-based entries into the market for scientific computers could greatly influence future operating-system standards. Features added in recent Unix implementations include a supercomputer technique known as disk striping and extensions to memory-addressing capabilities.

Many of the new scientific computers are built around new hardware architectures and multicomputer environments aimed at offering high performance at lower cost. Conformance to reigning Unix standards—such as Unix 4.2 from the University of California at Berkeley or AT&T's System V—is considered a must for new ventures. But these emerging versions of Unix also aim to yield more processing power by way of extensions or kernel modifications.

For suppliers of supercomputers and multiprocessor hardware, the trick is to exploit the strengths of new architectures while keeping Unix implementations compatible with the large installed base of Unix software, says Rebecca Hurst, software analyst with Yates Ventures Inc., Palo Alto. Most startups have limited software-development resources and opt to leverage the growing use of Unix by young engineers, according to Hurst.

FEATURES NEEDED. Standard versions of Unix lack the features needed to boost processing in many new architectures. "The definition of what Unix is today does not adequately support the two kinds of computers that will likely dominate the market in the next 10 years—the multiprocessor or parallel computer; and the distributed processors or work stations and personal com-



RACING STRIPES. A new Unix feature for the Convex C-1 is a supercomputer trick called disk striping.

puters," says Steve Emmerich, who is a Unix software engineer at Encore Computer Corp., Wellesley, Mass.

"People are going to want their computers to be exploited to the maximum, and if Unix does not provide the mechanism to do that, the industry will invent new mechanisms," adds Emmerich, who presented a paper on the topic at June's Usenix user meeting in Portland, Ore.

Last month, Encore unveiled Multimax, whose multiple 32-bit microprocessors run versions of Unix 4.2 and System V called Umax 4.2 and Umax V [*Electronics,* July 8, 1985, p. 18].

BORROWED TECHNIQUE. Applying a supercomputer technique known as disk striping in its implementation of Unix 4.2, Convex Computer Corp. of Richardson, Texas, says it can greatly speed up input/output performance of its 64-bit C-1 supercomputer. Available this summer as an addition to the standard C-1 package, disk striping repartitions a number of standard hard-disk drives so a single file can be stored on all of them at once in a parallel fashion. This software approach offsets the relatively low speeds of standard hard disks.

Disk striping increases I/O data rates fourfold without replacing any of the system's standard Fujitsu Eagle hard-disk drives, says Tom Watson, the Convex software engineer who added the disk-striping feature to Unix. Striping data over four drives, for example, will result in a transfer rate of 4 megabytes/s. The feature also enables the C-1 to handle supercomputer-size data files, which often exceed the capacity of one drive. The C-1's software automatically spreads large data files over several disk drives.

Convex's striping feature is transparent to the system user—data appears to be on a single storage device, Watson says. It has also added asynchronous I/O capabilities to its Unix system, enabling the C-1 central processor to crunch data at the same time that the system performs high-speed I/O.

Also planning to implement disk-striping in its version of Unix 4.2 is Denelcor Inc., Aurora, Colo. The parallel-supercomputer maker this year began late shipments of its 4.2-compatible HEP/UPX—believed by many to be the first available Unix-based operating system for a computer system that handles multiple data streams and multiple instruction streams.

"There is a widespread belief that Unix is not well suited for big-machine environments," says Burton J. Smith, vice president of research and development. "It is interesting that we, Cray Research, and ETA Systems [the Control Data Corp. supercomputer spinoff] believe Unix is well suited for our architectures." Smith says Unix's growing momentum in engineering-work-station markets has made it more attractive to large-computer houses. "If Unix versions running on supercomputers and work stations have the same basic file system, that will allow for much easier networking and use of the high-performance hardware."

Newcomers to computer markets also want to build on Unix's popularity. "Unix has proven easy to port to new architectures. That's why it has become the operating system of choice for so many new ventures," notes David L. Rome, marketing director of Alliant Computer Systems Corp., Acton, Mass. Recently, Alliant introduced a vector-processing, parallel-architecture FX/8 supercomputer [*Electronics,* July 29, 1985, p. 56].

The FX/8 runs under Concentrix, an implementation of Unix 4.2. Alliant restructured the 4.2 kernel to support two classes of processors residing in the system: computational units treated as a single resource, and an expandable pool of interactive processors. It also enhanced Unix to support 2 gigabytes of virtual address space and up to 256 megabytes of physical memory.

Dallas's Flexible Computer Corp., builder of the Flex/32 32-bit multicomputing system [*ElectronicsWeek,* May 13, 1985, p. 49], added user-selectable file-access and virtual-I/O extensions to Unix System V. "The key is being careful about how Unix is extended," notes Ray Naeini, vice president of software engineering. "In the future, I'm sure we will get to the point to where we will look around and see the need for another revision to make Unix compatible with multiprocessor environments. But the key is carefully extending Unix in a way keeping with the current standards." *–J. Robert Lineback*

RADIOASTRONOMY

DISH BOOSTS ACCURACY OF GEODETIC SURVEYS

DUISBURG, WEST GERMANY

A new German-built radiotelescope brings more accuracy to an international network of radiotelescopes built to perform geodetic surveys. With other radiotelescopes in the U. S., Sweden, and West Germany, the scope measures the period of the earth's rotation with an accuracy as high as ±20 μs and determines pole coordinates to within 2 cm.

Its developers—Krupp Industrietechnik GmbH in this Ruhr-area industrial town and MAN in Gustavsburg, near Frankfurt—optimized the telescope for radiotelescope measurements. Krupp designed the telescope's sophisticated tracking system while MAN performed the actual construction of the telescope.

The system's measurements confirm that: the American and European continents drift apart an average of one inch a year; in 24 hours, the earth's rotation can vary by 3 ms from its normal value; and the coordinates of the North and South poles may shift by up to 15 cm.

The 20-meter antenna dish is so rigid that winds and other weather forces do not appreciably deform the parabolic dish and thus falsify the measured results. Further, a novel computerized control scheme gives reliable and accurate tracking with a resolution of 1.24 arc-s and an accuracy of about 0.001°.

Basic to such geodetic measurements as continental drift, earth rotation, and pole-coordinate shift is a technique called very-long-baseline interferometry (VLBI). Two or more radiotelescope antennas at different spots in the world pick up the same signals from a distant radio source such as a quasar or fixed star. An atomic clock at each station gives a precise time reference, which is the same for the whole network. Because of the relatively long distances between the stations, the signals from outer space arrive at each antenna at slightly different times.

Scope's computerized control system tracks sources within 0.001°

SHARP. A 20-m radiotelescope at Wettzell, West Germany, boasts a resolution of 1.24 arc-s and a pointing accuracy of 0.001°. It is used for precise geodetic measurements.

SIGNAL DELAYS. At each station, magnetic tape records the signals as well as timing marks from the atomic clocks. Then, at a tape-evaluation center, the signals on different tapes are made to coincide and are superimposed to determine signal delay and signal-delay rate. From these delay and rate measurements, scientists can calculate the distance between stations and other geodetic parameters such as earth rotation, pole migration, and continental drift.

The stations receive signals in the 1.5-to-25-GHz range. From this spectrum, two frequencies, typically 2.1 and 8.2 GHz, are filtered out. The lower frequency corrects for diffraction effects caused by the ionosphere; the higher one makes the actual measurements of continental drift, earth rotation, and pole migration.

To illustrate the accuracy of the VLBI technique, the German radiotelescope, located in Wettzell, Bavaria, has measured the distance between itself and one at Fort Davis, Texas—8,417.562 km—to within 4 cm. It has measured antenna-to-antenna distance to the Swedish station, at Onsala, to an accuracy of 7 mm for the 919.661-km span.

The Krupp-MAN radiotelescope is designed to track a distant radio source accurately to within about 0.001° even under wind forces up to 50 km/h. Krupp achieves this with biased torque in the antenna's drive mechanism and an elaborate control system that eliminates interference effects and the reproducible errors inherent in the mechanical parts, according to Rudolf Timmes, head of the Systems Engineering Department at Krupp's Antenna Division.

The antenna has two dual-drive anti-backlash systems, one each for azimuth and elevation axes, to prevent pointing errors. Transistorized pulse-width-modulated servo amplifiers supply the currents for operating the motors—two each for azimuth and elevation.

The heart of the control system is a central servo computer built around a Digital Equipment Corp. LSI-11/23 microcomputer. It coordinates and supervises the control of the entire radiotelescope. Constituting the link between a station computer (which may be a mainframe), the operator, and intelligent subsystems, the servo computer calculates nominal position values and transfers them to the front-end units.

The system's control parameters automatically adapt to the antenna's changing speeds in azimuth and elevation or to the varying biased-torque requirements. "This way, an optimum control behavior is ensured within a wide operating range," Timmes says.

The central servo computer performs another unique function with the control system. For particular geodetic measurements, the operator feeds an almanac of quasars and fixed stars into the computer and picks a certain radio source from it. The computer then calculates the source's trajectory and feeds appropriate data to the front-end units, enabling the antenna to track the source continuously as the earth rotates in relation to the source.

The Krupp designers do not intend to stop at the 1.24-arc-s resolution and 0.001° pointing accuracy they have already achieved. In the works is a system with a 10-m antenna dish for submillimeter waves; this radiotelescope is to have a resolution of 0.1 arc-s and a pointing error of less than 1 arc-s, or 0.0003°.

–John Gosch

IC PRODUCTION

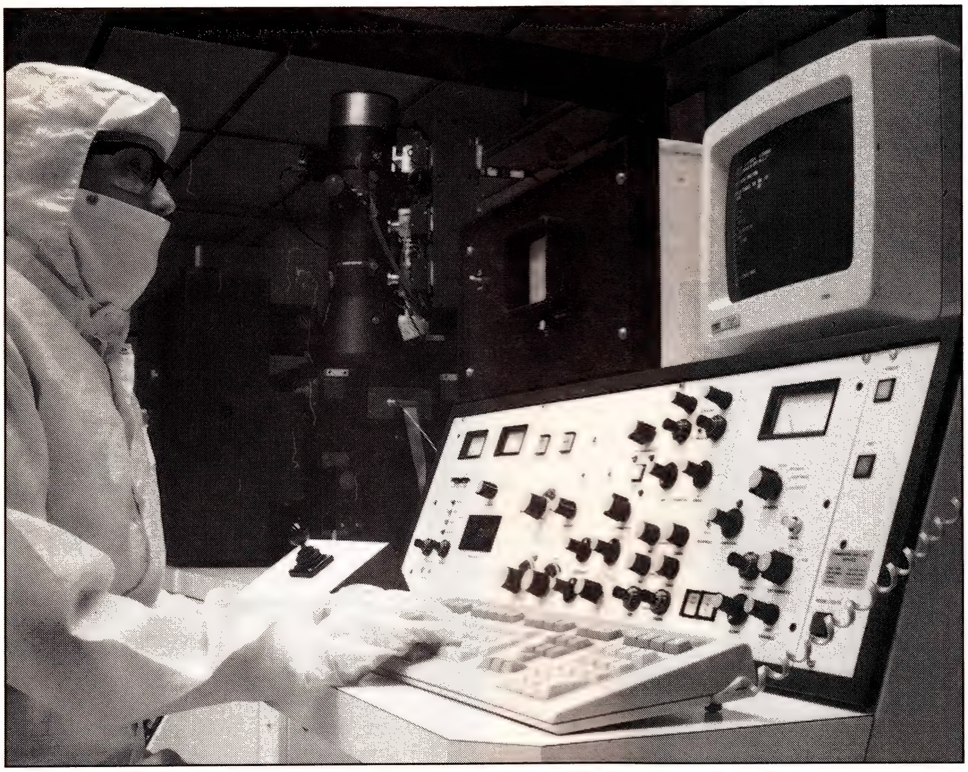
FAIRCHILD SPEEDS GATE-ARRAY TURNAROUND

MILPITAS, CALIF.

Fairchild Camera & Instrument Corp. is implementing a system that will reduce customer turnaround time for a prototype of a customized gate array from five weeks to two. Destined to be up and running by early 1986, it uses an electron-beam lithography system and a Cray 1S supercomputer for simulation.

The company expects to replace the one-to-two-week masking step entirely by using a $2 million Electron Beam Micro Fabricator from Cambridge Instruments Inc. Fairchild is one of the first companies to write directly on silicon in commercial gate-array applications; Texas Instruments Ltd., Bedford, England, will start a similar service this fall. On Aug. 2, Fairchild processed its first direct-write wafer—containing a prototype chip for a classified application in the B1 bomber.

Electron-beam lithography systems are typically used in the semiconductor industry to write the reticles for chip mask production and for writing directly on gallium arsenide wafers. The Cambridge Instruments' EBMF10.5 equip-



FAST SETUP. Fairchild's system includes an electron-beam fabricator and a Cray 1S supercomputer.

ment used by Fairchild has been shipping since March, mainly for development work and GaAs chip production. This was its first sale into the direct-write semicustom market. Parent Cambridge Instruments Ltd. says its only sale so far of an electron-beam system to a custom chip house was to UK start-up Array Logic. Ltd.

The electron-beam lithography system is only one part of Fairchild's effort to cut down customer turnaround time. A Cray 1S supercomputer for simulating chips and an extensive design network are the other parts. "The major advantage in this business is turnaround time," says Lanny Ross, general manager of Fairchild's Gate Array Division.

In a recent test, many of the steps involved in total turnaround—the electron-beam exposure, metalization of the pattern, assembly, and testing of a device—were carried out in the space of one day. "It's brutal, but we can do it," Ross says of the one-day timetable.

Fairchild's efforts to speed up the design cycle rely on a hefty investment in equipment for computer-aided design. "There are tremendously cycle-intensive steps in designing gate arrays and standard cells," Ross says. "We're creating an integrated design-automation and prototyping environment."

Acting on the belief that there is no substitute for full simulation of conventional designs to give designers the widest range of options and speeds, he signed the order for a Cray 1S supercomputer, which typically retails for about $6 million, to be installed by the end of September.

Ross says it will simulate in 15 minutes designs that take 1 to 10 hours on an accelerated minicomputer. "There is no [simulation-reducing] design methodology in the world that will allow you to simulate this fast," he claims.

CUSTOMER TIE-IN. Customers will be able to tie into the Cray and eventually to the production equipment through Fairchild design centers linked by satellite and by a packet-switching telecommunications network. This fall, Fairchild will also begin selling its own design system, based on a Digital Equipment Corp. Microvax II with a Tektronix Inc. graphics terminal. It will use Fairchild's design software.

Cambridge's Rick Ellis, district sales manager of the Semiconductor Equipment Group in Santa Clara, Calif., says that the key item holding up widespread use of the electron beam for direct writing is the resist on the wafers. A new direct-write electron-beam system from Perkin-Elmer Corp., the Aeble 150, has a throughput of up to 30 wafers an hour [*ElectronicsWeek*, June 3, 1985, p. 61]. Despite such capability, Ellis says, "the resist technology is not quite there yet to go at 20-30 wafers an hour." The problem of electron scattering with resist sensitivities currently of 10^{-5} C/cm^2 restricts the writing speed.

Fairchild will operate its electron-beam machine 18 to 20 hours per day, Ross says, producing about 40 different customer options a month. He says this is plenty of capacity for the time being, but the capacity could be doubled by another $1 million investment in hardware.

The resist barrier is slow in falling. Companies that are developing electron-beam systems are working toward throughput speeds that would make direct writing practical for more than just silicon prototype and developmental work.

Cambridge claims to have the largest installed base of direct-write electron-beam systems; its primary competition comes from N. V. Philips of the Netherlands and Jeol Ltd. of Japan. A few companies have recently dropped out of the electron-beam lithography market because of high developmental costs. *–Eve Bennett*

PERIPHERALS

JILTED BY IBM, CMI SCRAMBLES TO RECOVER

CHATSWORTH, CALIF.

Yet another peripherals maker is learning the perils of having IBM Corp. as its dominant customer. Computer Memories Inc. is casting about for ways to recoup from its devasting loss of business from the giant computer maker, which will not renew a contract expiring Dec. 31 to provide 5¼-in. Winchester disk drives for the Personal Computer AT.

The loss of any large contract deals a serious blow to a small company, but the IBM decision hits CMI particularly hard. In the quarter ended June 30, IBM business amounted to 81% of revenue; for the fiscal year ended last March 31, it was 67% of revenue. As of June 30, orders from IBM were nearly $50 million out of the company's total backlog of about $66 million. The delivery schedule to IBM for the remainder of the year remains firm, the company says.

PRESS ON. CMI must move quickly to cut expenses in advance of the contract's expiration. Layoffs and other cutbacks can be expected, says Irwin Rubin, chairman and chief executive officer. CMI has some 440 workers in Chatsworth and nearly 1,000 production employees in Singapore, but the decision on how many of them would be dismissed is still to be made. The company will push research on higher-capacity drives and seek additional customers, but even Rubin does not expect to entirely replace the IBM business.

CMI, which made $4.8 million on $51 million in sales for its first quarter, is in good financial shape; it has $19.4 million cash on hand and no debt. Rubin expects CMI to remain profitable through 1985, but the company needs new orders to stay in the black next year.

NO WARNING. The CEO says he had no warning of the IBM move, although he was aware of previous IBM cancellations. In recent years, IBM has axed drive makers Seagate Technology, Tandon, and Miniscribe, among other peripherals vendors [*ElectronicsWeek*, Feb. 11, 1985, p. 21].

Though IBM gave no specific reason for letting the contract expire, Rubin believes that IBM plans eventually to replace the CMI drives with its own, from growing production at plants in Minnesota and the UK. Seagate, of Scotts Valley, Calif., also supplies 20-megabyte drives for the PC AT, at a somewhat lower price than CMI's $580, according to industry sources. Another factor might have been CMI's inability to produce enough drives last year, thus holding up deliveries of the AT.

Last year, IBM accounted for 67% of CMI's revenue

Although the timing and terms of the cancellation came as a surprise, the decision itself could be predicted, notes James Porter, president of Disk/Trend, a Los Altos, Calif., consulting firm for the drive field. "IBM gave them more notice than the others, and is generally treating CMI with kid gloves," he explains. One reason for the soft treatment, in Porter's opinion, could be IBM's indirect stake in CMI; it holds a major interest in Intel Corp., which in turn owns a substantial part of CMI.

Porter earlier this year predicted that IBM's ramping-up of Winchester manufacturing would soon cut out external suppliers. He projects the company's production will top 100,000 drives this year and could reach more than 300,000 in 1986. Before the personal-computer boom overtaxed IBM's capability to build its own peripherals, the company kept as much of this manufacturing as possible in house. Now, the computer maker seems to be getting back to this policy, Porter believes. *–Larry Waller*

GRAPHICS

REAL-TIME ANIMATION TURNS DATA INTO IMAGES

PALO ALTO

A team of Stanford University researchers is working on an animation system that will allow scientists and engineers to track payload data from space vehicles and on-board experiments visually as events occur. The system could someday provide a greater degree of control over shuttle and Space Station operations—to simulate repairs, for example. And real-time simulation could train astronauts, much as flight simulation trains pilots today.

Scientists and engineers now see the results of most space-shuttle experiments as raw instrument data—screens full of numbers that the users must pore over to analyze. Many experimenters would welcome the interactive capabilities offered by a real-time animation system that translates data from space into graphic images.

These developments stem from the Stanford group's work for scientists who, like themselves, have experiments on board shuttle missions. Stanford's was Experiment 14, the Plasma Diagnostics Package, which monitored the reaction of space plasma to such outside forces as electron-beam perturbation.

The Stanford group—called Sunstar, for the Stanford University Network for Space Telescience Applications Research—set up its own "mission control" operation in Durand Hall on campus—a room full of video equipment and computer work stations that received live video and data feeds from the Johnson Space Center in Houston. The cooperative setup between the National Aeronautics and Space Administration and Stanford was NASA's first step in decentralizing payload and experiment tracking from mission control.

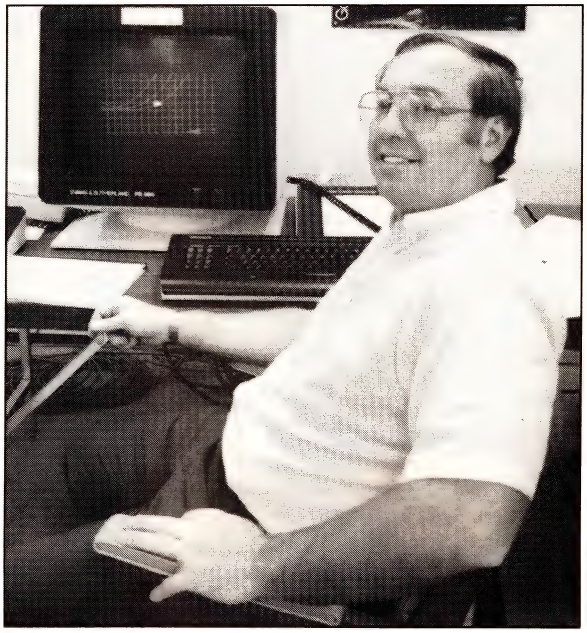
"The intent of their tying in here was to do some engineering work, some prototype evaluation of using remote science centers like the one at Stanford, so scientists could operate a little more interactively with their experiments," says Jack Seyl, deputy division chief in the Mission Support directorate at Johnson. "We wanted to see what kinds of systems and communications requirements they might need to establish by the space-station time frame [the mid-1990s] for conducting their science."

To further that capability, Michael J. Wiskerchen, senior research associate in electrical engineering and associate director for the Center for Aeronautics and Space Information Sciences at Stanford, says four hours of shuttle telemetry data was also acquired from NASA.

The data will be used repeatedly in the next 14 to 16 months, in conjunction with data from the plasma experiments, to help researchers develop an interface between an FGS4000 video generator from Robert Bosch Co. of West Germany, and computer-aided-design and -engineering work stations.

NO GOOD AS IS. The Bosch machine, which does very fast, high-precision animation, is "no good to us the way it is," says Wiskerchen, a six-year NASA veteran who joined the Stanford faculty in 1984. "It's a stand-alone system and we need a system that can receive data."

Although NASA isn't funding the interface development, claiming the Bosch unit is too costly for its budget, it is sponsoring research in real-time simulation with such equipment as Silicon Graphics Inc.'s Iris 2400 CAD work station and an Evans & Sutherland Computer Corp. PS330 CAE station, which tracked the shuttle's progress in real time during the last mission. A $250,000 grant allowed Stanford to purchase the



ANIMATED. Real-time animation of shuttle moves will help space experimenters, says Stanford's Michael J. Wiskerchen.

Iris system and to hire two graduate students to run it.

The Iris system, in fact, was shipped to Houston where it used real-time shuttle data to track the plasma-experiment package in relationship to the shuttle, the location of the sun, and the earth's magnetic field.

"A few pockets of experimenters think such [graphics and video] capability is a requirement," says Ted Connel, who is the head of the Data Systems Applications Branch at Goddard Space Flight Center, Greenbelt, Md. "The video requirement probably will develop. But researchers probably won't need the equivalent of a Bosch system for what they want to do." He says the Bosch equipment necessary for NASA's purposes would have cost $500,000.

Wiskerchen thinks that interfacing the Bosch video generator to CAD and CAE work stations, which can capture data and manipulate three-dimensional engineering blueprints of space vehicles, is a natural partnership for space applications. "Information on orbit and attitude of space vehicles could drive the animation," says Wiskerchen. "You could see it essentially in real time, and as exactly as any engineer could read numbers off the screen. Plus things you can't see—such as thruster firings—could. . . appear on screen exactly when they happen. Although the technology already exists, it's never been fully integrated," says Wiskerchen. "When the interface is completed, any CAD model can be transferred into the Bosch." Stanford and Bosch engineers are working on the project, and Stanford engineers hope to colicense the completed interface technology with Bosch.

'You could see thruster firings as they happen'

"We're interested in following development of the technology," says Connel. "And we would like to find a way to make the cost of those [Bosch] machines a little less." *–Denise Caruso*

MILITARY

NAVY SIGNS UP FOR JOINT AVIONICS PROGRAM

WASHINGTON

One battle in the war to get the U. S. military services to cooperate on equipment development has finally been won. The Navy has agreed to join an Army-Air Force demonstration program on an integrated avionics system for advanced tactical aircraft. Navy participation is to begin when the new fiscal year starts on Oct. 1.

The Navy's move appears to have been motivated in large part by a recently released General Accounting Office report that urged it to take part in the avionics program. But Navy representatives would not confirm that the GAO report was behind the agreement nor comment on the report itself.

The study says the results of this collaboration will be significant savings and standardized avionics. The GAO, a watchdog unit of Congress, estimates that an integrated avionics system would cut size, weight, and cost 30% to 50% compared with existing single-function systems.

Dan Hauser, the GAO evaluator in charge of the study, reported the Navy's decision and says the Navy will contribute $15 million to the budget for advanced development of the Integrated Communication, Navigation, Identification Avionics program. ICNIA could save the Navy up to $48 million in development costs, according to the GAO. Charles C. Gauder of the Air Force Aeronautical Systems Division's Avionics Laboratory at Wright-Patterson Air Force Base, Ohio, confirmed that the Navy has signed a memorandum of agreement to participate in ICNIA.

The Air Force established ICNIA in 1980, and the Army joined in 1983 after abandoning a proposal for a similiar program. In 1981, the Navy dropped its avionics program, the Tactical Information Exchange System, because it would serve only one aircraft. It had balked at joining ICNIA because it wanted to avoid being locked in before it knew what electronics it needed.

But the GAO report maintains that the program wouldn't restrict the Navy. "They are not tying themselves to a particular system, but would be advancing the state-of-the-art technology . . . and would be providing the basis for long-sought-after triservice avionics standardization," the report says.

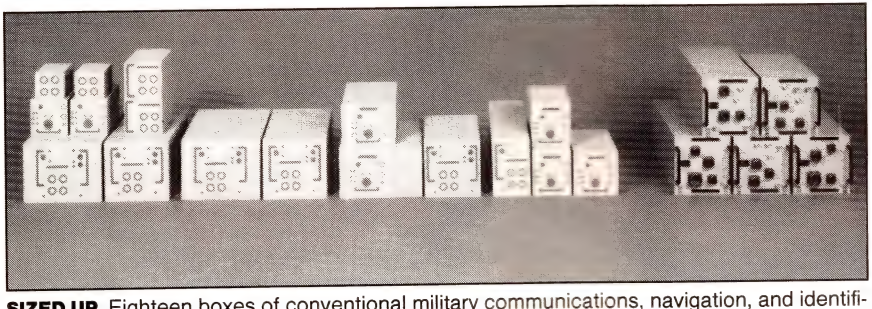
STILL EARLY. The GAO report emphasizes that the program is still in the laboratory and flight-demonstration stage, noting that full-scale engineering development is not expected to begin until the early 1990s. The report estimates that adding to ICNIA the two functions required solely for the Navy would be covered by the $15 million Navy contribution. The price tag for a separate Navy development program would be about $60 million. The Navy's $15 million will be added to $131 million for advanced development put up by the Army and Air Force.

The added functions the Navy requires are two digital data links. One is to be used as an all-weather aircraft-carrier landing system and as the control link between the E-2C command and control aircraft and the F-14A fighter. The other will convey target and position information among ships and aircraft in a task force.

The demonstration stage aims to develop two advanced models of the avionics package to demonstrate the capabilities of 16 current and planned functions operating in an integrated avionics package. Among these capabilities are the Joint Tactical Information Distribution System (JTIDS)—an L-band line-of-sight communications system that is also used for navigation—as well as an enhanced JTIDS system and an enhanced Position Locating and Reporting System, a line-of-sight system to provide relative position information and limited data exchange between users.

In June, the Aeronautical Systems Division at Wright-Patterson reviewed the two advanced-development models from prime contractors TRW Inc. and partners ITT Avionics and Texas Instruments Inc. During the review, company officials demonstrated signal processing using breadboard prototype hardware. "The results were very favorable," says Gauder. "They met our expectations."

As part of ICNIA's advanced development phase, the Air Force last month initiated a two-year effort to determine the functional requirements for each aircraft, as well as installation and cost-effectiveness studies. *–George Leopold*



SIZED UP. Eighteen boxes of conventional military communications, navigation, and identification avionics equipment, left, would be replaced by five boxes of ICNIA gear.

APPLIED DATA RESEARCH UPGRADES ITS MARKETING

WITH THAT DEPARTMENT NOW IN STEP WITH ITS TECHNOLOGY, A PIONEER IN SYSTEMS SOFTWARE COMES OF AGE

PRINCETON, N. J.

Until a year or two ago, Applied Data Research Inc. was renowned among those who follow the software business as a company with great technology but weak marketing. Now, say observers, ADR's marketing skills have nearly caught up with its technology.

"They've made major strides in marketing," says Scott Smith, a vice president at the Gartner Group, a Stamford, Conn., market research company. "They are still a better technology company than they are a marketing company, but you don't sell $60 million worth of data-base-management software without good marketing."

In recent months, the 26-year-old Princeton, N. J., systems software company has revamped its marketing strategy by reorganizing its sales staff and increasing its advertising budget.

ADR, which earned just over $37 million five years ago and passed the $100 million mark only last year, is now growing at a steady 30% to 40% clip—and figures to go on doing so for at least another five to 10 years.

"Let's just say it won't take us as long to reach the $200 million mark as it did for us to reach $100 million," says John Bennett, chairman and chief executive officer. At its current growth rate, ADR expects to eclipse $200 million in 1986 and, says Bennett, "We fully expect to be a $1 billion company" within seven years.

Bennett and ADR president Martin Goetz, who was the first person to hold a U. S. patent for a software program, hedge on pinning the company's recent success to any one factor. However, the reason appears to be a combination of technology, foresight, and revamped marketing strategy.

ADR's growth can be traced directly to its entry into the data-base-management market for IBM Corp. mainframe computers. In 1978, ADR bet heavily on data-base management in a reversal of its strategy of in-house development: it purchased Insyte Datacom Corp., a small company in Dallas that had developed a relational DBMS that showed great promise.

BIG TICKET. "We knew data-base management was a big, growing market," says Bennett. "It was very clear that it would be the largest part of our growth." Just how big was probably not so clear. Demand for data-base-management systems "has really taken off in the last two years," says the Gartner Group's Smith. "It's now considered a mandatory item in information management. It's a big-ticket item."

Sales of ADR's Datacom/DB product line, which also includes DataDictionary, DataQuery, and DataReporter, now account for more than a third of total revenue, and the company expects continued growth in that segment of its business at an annual rate of 50%.

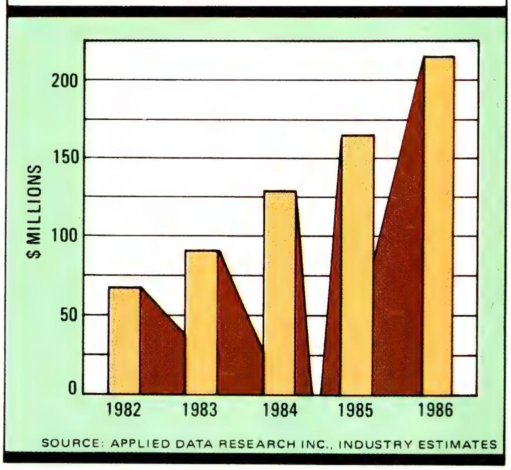
Moreover, ADR poured $21 million into research and development in 1984; at 16.2% of total sales, its R&D spending ranked 15th in terms of percent of sales among all U. S. companies last year and tops among U. S. software companies. While that spending has helped boost revenues, it hasn't helped the bottom line, as ADR suffered a $3.1 million loss in its second quarter ended June 30.

Moves by the competition in the mainframe-software arena—particularly IBM Corp., the largest software house—also bit into ADR's results, says software analyst William Shattuck of Montgomery Securities, San Francisco.

However, Shattuck backs up ADR's projections of growth, forecasting revenues of $165 million in 1985 and $215 million in 1986. ADR's earnings for all of fiscal 1985 are still expected to exceed $9 million versus $7 million in fiscal 1985, industry observers note.

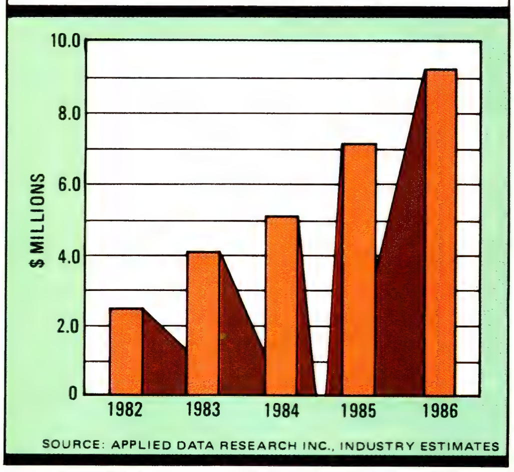
ADR's R&D spending is likely to continue. "We've got to spend more today enhancing our product than we did building it yesterday," says Bennett. "The smallest development team we'll have is when that product is being built.

APPLIED DATA RESEARCH REVENUE . . .



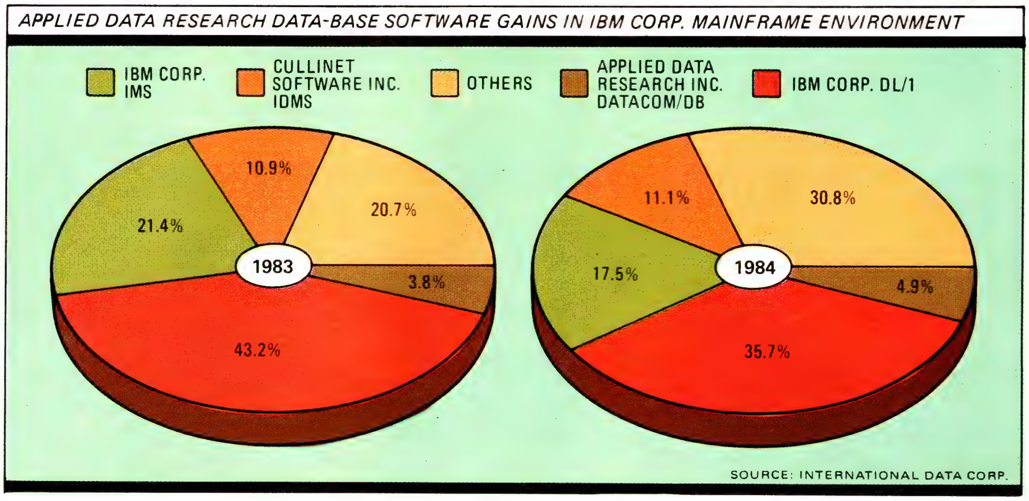
SOURCE: APPLIED DATA RESEARCH INC., INDUSTRY ESTIMATES

. . . AND EARNINGS ARE SET TO TAKE OFF



SOURCE: APPLIED DATA RESEARCH INC., INDUSTRY ESTIMATES

APPLIED DATA RESEARCH DATA-BASE SOFTWARE GAINS IN IBM CORP. MAINFRAME ENVIRONMENT



SOURCE: INTERNATIONAL DATA CORP.

PROMOTING. ADR president Martin Goetz (left) and chairman John Bennett talk up data-base management systems.

As it matures, we put more people on the team." Software, he says, is not a business where one can safely sit back and rest on the laurels of success. "It's like stopping on the Autobahn in West Germany—if you stop, everyone else will go right by you so damn fast."

"Their product offering is extremely strong," says Shattuck of Montgomery Securities. "And the main reason for the excitement now, at least on the stock market, is that you're dealing with a data-base company rather than a general systems company. It gives them greater flexibility, greater strength. It is their single most dramatic change."

In 1983, Datacom/DB was installed on 3.8% of IBM Corp. mainframe computers being used for DBMS, according to a survey by International Data Corp., Framingham, Mass. By 1984, ADR's market penetration had increased to 4.9% (see charts).

Bennett says market research discovered that ADR's name was not well-known among the executive ranks and that a lot of potential customers who did know of the company had no idea it was in the DBMS business. As a result, the company reorganized its sales force and boosted its advertising budget from $750,000 in 1983 to $2 million in 1984 and $3 million in 1985. But it says it has tried to avoid hype.

TELLING USERS. "Since we've been known as a high-tech company for years, we're accessing that base," says Bennett. "We've increased the budget in terms of visibility, not sales hype." Adds Goetz: "We've gotten our message out to the people we sell to."

Among the changes in strategy have been new efforts at selling to the corporate executive who may never have to use the product, but nonetheless will ultimately have to sign the check to pay for it. ADR now holds seminars for executives, as well as for other persons with varying degrees of knowledge and involvement with the product. By selling to several levels of a company, says Alex Plavocos, director of DBMS marketing, ADR can overcome well-entrenched competition.

ADR is not in the business alone, of course, and its chief competitors—IBM and Cullinet Software Inc.—are hardly weaklings. "IBM's sales force has been making a lot more noise about DB2," IBM's relational DBMS, says analyst Shattuck. He expects IBM to hurt ADR at least a little bit, "even though technically DB2 is an inferior product, I think."

There are four different approaches to data-base management. The first was file managers such as IBM's VSAM, which was developed in the 1950s and 1960s and is used as the primary DBMS in about 43% of the installed base of 42,000 IBM mainframes.

Hierarchical data-base managers, such as IBM's DL/1-IMS family, which controls about 42% of the non-file-management DBMS, represented the next stage of DBMS development. These were followed by network DBMS systems, such as Cullinet's IDMS.

RELATIONAL APPROACH. The most recent approach, and the one on which ADR is basing its future, is the relational DBMS. Less complicated for the user than the other approaches, only three steps are required to access data at any time. Relational DBMS is also faster: it eliminates the "navigation" through different subsets that the computer must do in other systems, representing data instead in rows and columns.

One of the difficulties facing ADR and others trying to break into this marketplace has been that none of the different approaches is truly compatible with any other. To update from a VSAM system to Datacom/DB, a company would have to transfer all of its data files in what would become a lengthy and expensive process.

ADR met that challenge in April with the introduction of ADR/DL1 Transparency, a package that permits the migration of data from a DL/1 or IMS/DB DBMS to Datacom/DB in only a few days. The package automatically transfers data to the relational structure, yet modification of existing DL/1 programs is unnecessary because the old program can access Datacom/DB as if it were accessing DL/1. *–Tobias Naegele*

BOTTOM LINES

HIGH-TECH FIRMS FACE CREDIT-RATING TRIMS

Some leading U. S. computer and electronics companies could see their credit ratings reduced in the next three to five years because of increased competitive pressures from foreign manufacturers and rising sensitivity to economic downturns, according to Moody's Investors Service Inc. "The expansion of computers beyond general-purpose mainframes into numerous low-cost specialty segments has made the demand for processors more elastic and the industry more sensitive to economic fluctuations," Moody's says. The New York credit-rating agency says the credit rating of the 15 largest U. S. makers of computers, semiconductors, and office-automation equipment has fallen from Moody's Aa3 level in 1979 to slightly over its A2 rating today. These companies, according to a new Moody's study of the industry, "could still encounter a downward drifting of industry credit quality through the end of the decade." The study adds, however, that the future of the individual companies' credit ratings will depend on how each responds to future business challenges.

HP GIVES $3.3 MILLION FOR AI RESEARCH

Hewlett-Packard Co., Palo Alto, has awarded a $3.3 million grant for artificial-intelligence research to the University of Pennsylvania's School of Engineering and Applied Science. According to the university, the grant will support work now under way at Penn in AI. Under terms of the award, HP will supply the school with 40 high-performance work stations, along with software and support services. HP will deliver 20 systems to the school this year, 10 next year, and 10 in 1987. Penn said the HP grant brings to about $15 million the amount of funding its engineering school has received for AI research that will be carried out over the next five years.

DATASPEED OKAYS ACQUISITION BY LOTUS

Dataspeed Inc., San Mateo, Calif., said its shareholders have approved the terms of a previously announced agreement covering the company's acquisition by Lotus Development Corp., Cambridge, Mass., for about $6.5 million. Dataspeed makes two products that receive real-time stock-market quotations, broadcast to users by FM sideband radio. One of the products is designed for use with a personal computer.

PLAYERS

MORISHITA'S JAPAN PLAN: PAY FOR MARKET DATA

TOKYO

To Shigeru Morishita, his new job as head of Dataquest Japan Ltd., the Japanese subsidiary of market researcher Dataquest Inc., is more than the latest stop in a career spent in marketing and market research. It is also a chance to persuade the Japanese to pay for something they expect for free.

NEW TACK. Morishita aims to expand Dataquest's efforts in Japan.

The reason, he says, is that it goes against Japanese habits to pay for information. In Japan, most people think of information as a free resource rather than as a commodity for sale to those who can afford it. Thus, he says, the market research business must demonstrate to its clients that information can lead to profits far more substantial than its costs.

He also sees a chance to increase demand for his company's services while bringing benefits to both Japan and the U. S. "Dataquest now has 300 persons in San Jose, but their data on U. S. industry is not necessarily in a form suited to the needs of Japanese firms," he says. He plans to provide that data in a form that meets the needs of his Japanese clients.

Morishita also is gearing up for greater flow of information from Japan to the U. S. as Japan continues to develop new technology. "We need more researchers to gather data, determine the impact of the technology, and put it in the U. S. data base."

During the next year, Morishita hopes to open the window wider on Japanese industry in fields in which Dataquest provides services. He plans to increase his team of six researchers, including himself, to 20. "I will take charge of developing them for improved personal growth and efficiency. No longer will they operate under remote control from San Jose."

Morishita also believes he should help educate Japanese research companies that are nominally competitors. The best-known ones were spun off from internal groups in securities or other companies, and Morishita wonders whether they have really learned how to serve outside clients. Success in such educational efforts is important at this time because the Japanese economy is shifting rapidly from secondary to tertiary industries, which cannot grow without needed information. Morishita's work is expected to help the government, as well as industry, by making available to policymakers information not previously obtainable.

But Morishita also sees an important product of his business as "trust in Dataquest rather than information. Once a client loses faith it will cancel."

His new post at Dataquest is just one more challenge for Morishita, who managed a succession of small pioneering groups during his 32 years at his former employer, Fuji Photo Film Ltd.

Morishita learned about market research during his graduate studies in business administration at Miami University, in Oxford, Ohio, which he attended on a scholarship from the U. S. Army of occupation. He learned market testing techniques during a summer job at Procter & Gamble Co., Cincinnati, and product performance sampling at the research laboratories of Merck & Co., a pharmaceuticals and chemicals manufacturer in Rahway, N. J. Returning to Japan, he joined Fuji Film and led the first group to do nationwide market research in Japan. *–Charles L. Cohen*

EUROPE RANKS HIGH ON KAUFMAN'S LIST

PARIS

Business practice in the U. S. is usually to hammer down a solid piece of the domestic market for new products before looking to export beyond the sea. But Phillip Kaufman isn't about to wait.

Kaufman is president of Silicon Compilers Inc., the San Jose, Calif., company created by Carver Mead, David Johannsen, and Edmund Cheng to develop silicon-compilation systems software based on Johannsen's methodology. By his reckoning, the time is ripe to attack the European market, even though demand is just beginning in the U. S. for these systems that derive an integrated-circuit design from system specifications.

MOVING. Silicon Compilers' Phillip Kaufman isn't waiting to succeed first in the U. S.

His reasoning, expressed on a recent swing through Great Britain, France and Germany, seems solid enough. To begin with, he expects Europe to constitute at least one third of the world market for silicon-compilation software—too high a portion to be ignored. In addition, despite a growing number of related research projects in industry and in academia, no native European companies are ready to bring a competing product to market. The company has three products, Genesil 100, 400 and 500, for one, four, and from five to ten users respectively. It is also in the circuit design business, using its own software.

Kaufman, 42, joined Silicon Compilers in 1982 after a stint as general manager of microprocessor operations, director of corporate strategic planning, and director of engineering at Intel Corp. The University of Michigan graduate (BSEE and MSEE) admits that the entire field of silicon compilation is still surrounded by a mixture of skepticism and mystery. "When you tell people you have a silicon compiler to sell, the most common response is 'You mean you have Fortran on a chip?' " he chuckles.

Such attitudes mean that, for now at least, one of the principal objectives of Kaufman and Silicon Compilers is the education of potential customers. In an effort to bring people and silicon-compilation systems together, Kaufman and his staff lugged two Digital Equipment Corp. Microvax II computers, equipped with Silicon Compilers' Genesil 100 software package, around Europe.

"The most important thing is that people see what the possibilities are, to realize the potential of the system," Kaufman declares. He claims that an experienced system designer needs only a week of training to work with Genesil software, thus making the full-day introductory sessions he was holding in Europe sufficient for participants to see clearly what they might be able to do.

Genesil's track record is impressive. Kaufman says that when DEC used the software, the company took only five months to design the Microvax I, a very large-scale integrated-circuit version of its VAX-11/730 superminicomputer. Another success was Seeq Technology Inc.'s Ethernet local-area-network controller. The company believes that Genesil gave it an 18-month lead over its competition, according to Kaufman. *–Robert T. Gallagher*

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WILL REAGAN CUT ENOUGH RED TAPE TO AID EXPORTS?

INDUSTRY STILL FEARS REGULATORY STRANGLEHOLD

by Karen Berney

WASHINGTON

Electronics industry lobbyists, who have battled 2½ long years for a liberalized Export Administration Act, are calling the legislation signed into law July 12 a major step forward for high-tech exporters. But the job of turning the good intentions of the lawmakers into action belongs to the Department of Commerce, which is drafting the regulations to execute the act's provisions. And what Congress gives, Commerce has the power to take away—although the legislators will not take kindly to being steamrollered by the Executive Branch.

"There is a lot of positive language in the legislation. But whether it will translate into a better deal for electronics exporters depends on regulatory implementation," says Thomas Christiansen, manager of trade relations for Hewlett-Packard Co. What he and his colleagues will be tracking carefully is strict compliance with four particularly important provisions. These mandate:

- The elimination of all controls on low-technology items sold to U. S. allies and the creation of a fast-track approval mechanism for all high-technology exports to them.
- Curbs on the President's ability to terminate contracts and use export controls for foreign policy purposes.
- Giving greater weight to the availability of technology from foreign sources when making decisions on imposing export controls.
- Decontrol of equipment containing embedded microprocessors, especially scientific and medical instruments, unless the goods would jeopardize U. S. military interests.

Most significant of these, lobbyists agree, is the lifting of controls on sales of low-tech items to members of the Coordinating Committee for Multilateral Export Control (Cocom), which is made up of North Atlantic Treaty Organization nations, minus Iceland and plus Japan. Now U. S. firms face a selling disadvantage in cases when their products appear on the Commerce Department's commodity-control list, even though identical products made by foreign firms are not on the Cocom list. The act would bring the domestic-only list in line with the Cocom version, thereby eliminating the need for 40% of the licenses now needed for sales to Cocom nations. For instance, the provision will allow IBM Corp. to export its 4331/11 computer or Data General its Eclipse 0/30 to West Germany without licenses.

For high-tech exports to Cocom, Congress has mandated a fast-track system involving automatic approval 15 to 30 days after license request.

SUPERVISION. HP's Thomas Christiansen advocates tough congressional oversight.

Low-tech decontrol will immediately drain the pipeline of 15,000 to 25,000 cases of a total annual workload of about 120,000 licenses. That should please the majority of members of the American Electronics Association, who in an AEA survey on export controls cited red tape and licensing delays as their biggest problem.

Companies also are hailing the codification of distribution licenses—a license applied for every two years to cover bulk shipments to overseas U. S. distributors. Distribution licenses are extremely important because they "eliminate an unbelievable amount of paperwork," explains Jim O'Connell, director of government affairs for Control Data Corp. Now that they have the force of law, "we can have much more confidence in our long-term business plans," he says. Similarly, Congress has authorized multiple exports of technical data to a U. S. company's foreign affiliates, joint-venture partners, and contractual licensees in friendly countries under a new license.

Further streamlining the system is the requirement to cut by a third the time currently designated for each phase of the license review process. In addition, Cocom has received increased funding to deal with its backlog of cases.

HANDS OFF. Perhaps as important as what the EAA does is what it doesn't do, maintains Sol Glasner, manager of government relations for Sperry Corp. The most hotly debated EAA proposal was the call from Sen. Jake Garn (R., Utah) for an enlarged Defense Department role in reviewing U. S.-Western high-tech trade. The House killed the amendment, but for a while the industry stood to see its hard-won gains wiped out in one fell swoop, Glasner asserts.

But though Congress didn't expand the DOD's influence, it didn't exactly clarify it either. That's just one ambiguity in the legislation that lobbyists say could backfire on the industry.

The Senate maintains that DOD review of Western trade licenses is legal under unrevised provisions of the 1979 act, but the House says it is illegal under the 1985 amendments. "The only way this is going to be settled is by judicial action," predicts Ray Garcia, director of legislative affairs for Rockwell International Corp. An exporter could sue the government if the DOD denied a license to an uncontrolled country, he argues.

Contract sanctity is also of vital concern to U. S exporters. The EAA states that the President cannot order U. S. contracts broken until he certifies to Congress that a "breach of the peace" poses a serious threat to the strategic interests of the U. S. What isn't spelled out is the meaning of "breach of the peace."

"Unfortunately, Congress has rendered contract sanctity nearly useless by setting forth a standard wide enough to drive a truck through," declares Harold Lucs, former minority counsel to the House Foreign Affairs Committee.

Broad discretionary power is also built into the foreign-availability provision. The act directs the Secretary of Commerce to determine which technologies are readily available to communist countries from non-U. S. sources. If it cannot be shown after six months that the technologies are not available, the Commerce Department must take the item off the list, unless the department itself obtains a 12-month extension.

Despite the wide time limits, foreign availability sounds good to Bill Tolley, director of legislative affairs for Harris Corp. "There are relatively few technologies left for which the U. S. can claim a global monopoly," he notes. Harris has lost sales opportunities for such products as radios and small computers because, "by the time our license materialized, our potential customer had gone elsewhere."

He hopes foreign availability will result in a shorter commodity-control list, although William Barth, director of Commerce's new Office of Foreign Availability, thinks not. "Foreign availability is not going to give way to massive decontrol [of sales to non-Cocom nations]," he says. Barth says his staff is studying foreign availability of such products as shipboard and collision-avoidance radars.

NEED FOR OVERSIGHT. "Let's face it, there are very few airtight provisions that Commerce can't wiggle out of and the DOD can't obstruct," remarks Howard Lewis of the National Association of Manufacturers. So the key to keeping the Executive Branch in line will be tough congressional oversight, concludes HP's Christiansen.

The crux of the matter is ineffective licensing management

Oversight of the EAA is the top priority of the House Foreign Affairs subcommittee on international economic policy and trade chaired by Rep. Don Bonker (D., Wash.), an industry advocate who has promised to hold the DOD at bay. The subcommittee plans to hold one oversight hearing a month and frequent surprise visits to the Commerce Department, says staff member Jennifer White.

Hearings will focus on Commerce's management because, in the subcommittee's opinion, the crux of the matter is not compliance but ineffective management. Toward that end, the EAA creates the position of undersecretary for export administration.

That kind of clout is needed not only to revitalize management but also to counter DOD hardliners. "The subcommittee wants someone who will be able to throw weight at the White House and stand up to Richard Perle," claims White. Perle is the assistant secretary for international security policy and the architect of tighter export-control policies.

Despite Congress's attempt to strike a balance between national security and economic competitiveness, critics say it still has not come to grips with the key issue: what does the U. S. want to control? Whereas Congress should be working to define and control truly strategic technology, it is bogged down in cleaning up the paper factory that has grown around the current mechanisms.

For now, the DOD continues to add to the 700-page list of strategic technologies that the EAA earmarks for commodity control. In the words of Walter R. Edgington, vice president of marketing for GTE Government Systems Corp., the list is so extensive that "it would make an excellent index into basic electronics technology for nonengineers." ☐

TRIPPING UP THE EASTERN BLOC

Though withholding technology from the Eastern Bloc is called a straw man, Department of Defense sources say that the cost to the Warsaw Pact countries in time and money is real and substantial. For example, by denying the Eastern Bloc more than 2,000 sensitive licenses for improved signal-processing technology and surface-acoustic-wave materials, the U. S. will force the Soviet Union to spend \$6.6 billion to \$13.3 billion from 1985 through 1997 and three to five years in development time, according to Pentagon officials.

The Militarily Critical Technologies List, which is the basis for denying these licenses, contains more than 4,000 entries. Under orders from Congress, the Pentagon has been working on a priority ordering of the list. The result is a revised list of "technologies most critical to the missions of the 1990s," which includes more than such obviously critical technology as that associated with the Stealth bomber, advanced composites, and robotics. It also covers a wide variety of information in many fields. A sampling of these critical technologies gleaned from Armed Forces lists includes:

Communications, Command, and Control
- Solid-state phased-array modules.
- Expert systems and natural-language processors.
- Ultraviolet and infrared multispectral mappers.
- Manual and automatic countermeasures.
- Receivers with a compression ratio exceeding 100.
- Autonomous navigation-attitude determination.
- Laser gyros.
- Magnetometer systems with compensation know-how.
- Communications switching technology.

Information Systems
- Fault-tolerant and secure hardware and software.
- Parallel processing.
- Computer-aided-engineering tools for software design, configuration management, testing, and validation.
- Holographic/laser memories.

Electron Device and Components
- CAE integrated-circuit design including algorithms for device modeling and scaling and automatic test generation.
- Cell libraries.
- Beam-probe tests of chip circuit nodes.
- Wideband matching networks and device mounting.
- Electronic tube and charged-coupled devices.
- Spread-spectrum modems.

Optics
- Laser transmitters with a damage threshold greater than 250 mW/cm^2 and contrast ratios above 100 : 1.
- Adaptive optics, low-loss beam splitters, and high-speed switching.
- Infrared, optical, and ultraviolet sensors.

Undersea Systems
- Interarray-processing correlation techniques.
- Wake-characteristic suppression techniques.

EUROPE READY TO START R&D ON COMPATIBLE TELECOM NET

COMMON MARKET'S RACE PROGRAM LOOKS TO FIBER-OPTIC LINKS

by John Gosch

BRUSSELS

The European Commission is on the offensive, seeking to keep Europe competitive in world markets for communications technologies. Together with the electronics industries of the Common Market countries and the postal telecommunications administrations, it has mapped out an ambitious research and development program from which to build common integrated broadband communications (IBC) networks by 1995.

Called RACE (Research and Development in Advanced Communication Technologies for Europe), the program is set to begin within months, although financing is in place only for the initial, definition, phase. It aims at laying the groundwork for Europe-wide compatible IBCs that will embrace present network structures such as public switched telephone networks, integrated services digital networks, cable-TV systems, and mobile communications, as well as the more advanced services such as video telephony, videoconferencing, and high-definition TV.

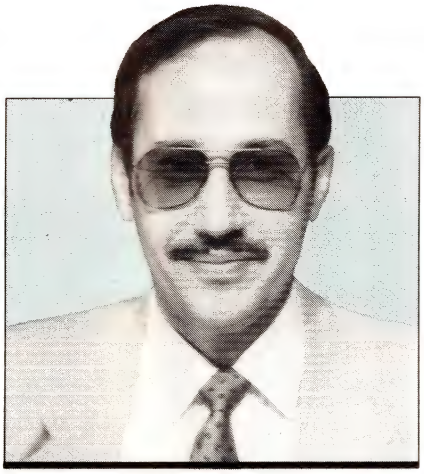
RACE will stress timely R&D with particular emphasis on all-digital switching and fiber-optic technology. Glass-fiber cables are being considered for signal transmission over trunk and local lines extending down to, and perhaps including, the customer's premises.

SNAGS ALREADY. The EC does not intend to allow Europe to once again fall behind the U. S. and Japan (see "Why Europe is uniting to build RACE," opposite). RACE is already running into snags, however, with some potential participants only lukewarm about the idea of a cooperative effort.

In pursuing its goal, RACE will steer Europe's current work on narrowband ISDNs toward a standard infrastructure so that each country's IBC network is compatible with that of its neighbors. This is to avoid the incompatibility that plagues the narrowband ISDN systems being put up in some parts of Europe.

"If we want the industry to enjoy the benefits resulting from economy of scale and postal administrations to be able to offer economical broadband services, we must have common standards," says Roland Hüber, the EC director for analysis and program preparation. "We must not repeat the idiocy of the past and program noncompatibility into European networks right at the start."

Many of the companies that helped blueprint Esprit (the European Strategic Program for Research in Information Technologies) also helped draw up RACE: Siemens, AEG, and Nixdorf Computer from West Germany; Groupe Bull, Thomson, and CIT-Alcatel from France; Plessey Co., General Electric Co., and ICL from the UK; Ing. C. Olivetti & C. and SGS Microelettronica from Italy; and Philips from the Netherlands.



WANTS STANDARDS. EC director Roland Hüber says common IBC standards are necessary for economical broadcast services.

RACE could dwarf Esprit, Europe's first major electronics program, which the commission proposed three years ago [*Electronics*, Aug. 25, 1982, p. 85]. Unlike the R&D-oriented Esprit, which aims at many aspects of information technology, RACE has a precise focus. It is "to establish the prerequisites and the technological base for an IBC infrastructure and economical broadband services by the mid-1990s," says Hüber, who helped map out RACE's 18-month definition phase.

Following the definition phase, the first phase, in 1987-92, will develop the technology base for the IBC network and help the CEPT (Conférence Européenne des Postes et Télécommunications) and CCITT (Comité Consultatif International Téléphonique et Télégraphique) organizations in formulating specifications and standards. The second phase, in 1992-97, is to develop the base for enhanced IBC systems and services beyond 1995. The question of financing the first and second phases will be settled at a later time.

FIRST MONEY. Thus far, the Brussels planners and the industry have formulated exact objectives only for the definition phase. For this phase, about $30 million will be split evenly between the EC and industry, financing the start of 11 projects. These include developing an IBC network reference model with a suitable architecture, defining the IBC terminal environment with a view toward cost-effective equipment, and assessing future applications.

The remaining eight projects to be started during the definition phase address preliminary R&D with long lead times—projects that the EC considers key communications-related technologies. They include investigations into high-speed integrated circuits for IBC functions, high-complexity ICs for video digital signal processing, integrated optoelectronics, and switching systems for broadband signals.

The others involve investigations into passive optical components, devices for high-bit-rate long-haul links, dedicated communications software, and technology to implement large, low-cost, general-purpose, flat-panel displays. In handling these R&D projects, some coordination with Esprit and related EC programs may be necessary to avoid duplication of work.

By and large, Europe's industry and network operators welcome the RACE program. "We think that in the long run the research and development involved can be carried out effectively only if European countries act together," says Gerhard Hausmann, an official in the international affairs section of West Germany's Postal and Telecommunications Ministry in Bonn. "But, for economy, the work should not duplicate what's already being done as part of Esprit and other programs."

Philips, the Dutch electronics giant, takes a positive view as well, characterizing RACE as "a laudable attempt to mount an offensive against Japanese competition with the combined strength in research and development that Europe can muster."

NO BRITISH RESERVE. UK manufacturers appear to be the most enthusiastic RACE supporters, and for very good reasons. Their telecommunications market is the first in Europe to be liberalized and to feel the chilling winds of competition. Even now, RACE is seeking to limit the number of main exchange switching systems that network operator British Telecom wants to buy from foreign suppliers. Another weakness is that British manufacturers lack a strong export market base. Therefore, Plessey, the biggest UK communications house, is strongly in favor of RACE.

Frank Chorley, executive chairman of Plessey Telecommunications and Office Systems Ltd., emphasizes the long-term nature of the RACE program and the need for the initial definition phase to lay sound foundations for subsequent development. "The reluctance of national governments to fund a full program at this stage makes it doubly important for the PTT, administrations, and industry to produce a viable economic and technical program over the next 18 months," he says. "Otherwise, Europe will fall behind again as it did with computers."

But not everybody shares this interest in RACE; not surprisingly, manufacturers' responses to the program seem to reflect their relative strengths and their perception of how the market will develop. A case in point is Munich's Siemens, which takes a rather dim view of some of the program's aspects.

Well advanced in developing narrowband ISDN systems, Siemens is aiming to get such equipment on the market by 1988. It will then gun for broadband ISDN networks, which it thinks can be ready by 1990 or 1992, ahead of the RACE timetable. "Our goal is to implement an ISDN-based wideband net still in this decade and then get it to market fast," says Norbert Beninda, executive director for marketing at the company's Telecommunication Networks and Security Systems Group.

Some criticize EC for getting involved, find timetable too slow

Given the company's strength in communications, the Siemens feeling seems to be that it can go it alone and that RACE would only slow the momentum it has gained in ISDN work. "The time plan of RACE is off the mark," Beninda declares. "The program is too slow, ties up development resources, and only helps the weak companies."

The French PTT is even more outspoken in its reservations toward the program. "I wouldn't give RACE more than a 1-in-10 chance of ever coming to fruition," asserts one government official. "For one thing, the fact that the EC is handling the program is a drawback. This should be the business of the CEPT. That the EC is getting into the program just imposes another, and unneeded, level of bureaucracy.

"The other point is that realizing such a product is going to take an enormous amount of resources, perhaps as much as all of what Europe can muster," the official goes on. "That implies that if the program is to succeed, each country must have enough confidence in RACE to devote all of its energy to it, rather than dispersing that effort on its own proprietary broadband program. I really don't know whether the EC has the credibility necessary to attract that kind of loyalty."

If RACE were to be watered down or to collapse, Europe might face grave consequences in communication technologies, the EC warns. Most of Europe's future markets would then go to U. S. and Japanese companies, predicts Hüber. "If nothing is done, no European companies may be around in five years that can truly call themselves high-tech companies. They may well have degenerated to sales outlets for American and Japanese suppliers." ☐

WHY EUROPE IS UNITING TO BUILD RACE

Behind the RACE initiative is the awareness that Europe will fall behind the U. S. and Japan in communications if it does not make a concerted effort to stay abreast in the world market. This awareness has the European Commission and the electronics industries of its member countries on the move. Europe's telecom industry is still pretty strong, both technically and commercially. It operates in a market that accounts for one third of the world's communications-equipment sales, and many companies do substantial overseas business and are well into the development of switches for integrated services digital networks, for example.

But EC experts say that Europe's position is starting to erode. Its share of the world's total exports has been dropping at an annual average of 1% in the 1980s. "Also, while sales of traditional equipment, including spare parts, on foreign markets are going fairly well, exports of systems using new technologies are doing poorly," says Roland Hüber, the EC director responsible for analysis and program preparation. "On the other hand, Europe is importing more and more sophisticated gear."

This trend could accelerate, given the pace of Japan's advances in electronics and intentions in communications. EC officials point out that Japan is pushing ahead with a master plan in communications that calls for the outlay of $170 billion by the year 2000. Another threat comes from the U. S., where the deregulation of communications has led to free-for-all markets, enhancing competition.

In Europe, by contrast, the stodgy and slow-moving government monopolies tend to impede innovation. Because the postal administrations are the prime customers for communications gear in most countries, advances in technology can be expected to outpace innovation. Further retarding competitiveness and innovation are Europe's fragmented markets.

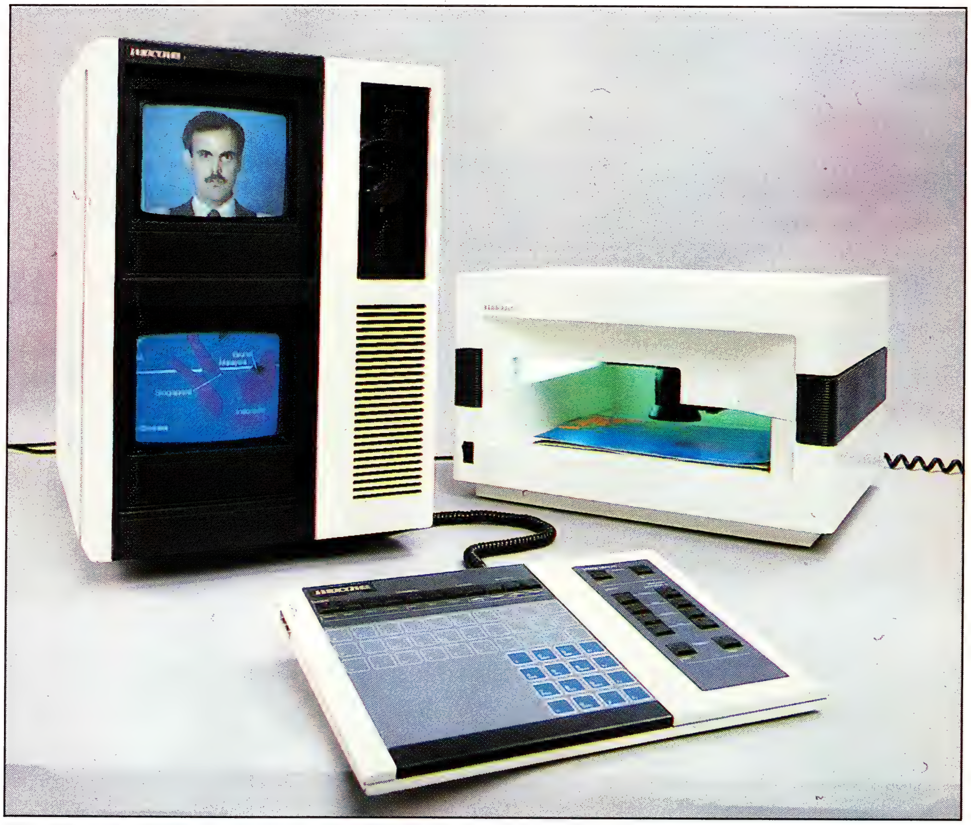
National and protected markets have also led to an enormous waste of resources, says Maurice English, an official in the EC's Information Technologies and Telecommunications Task Force. He points out that while Japan spent $1.6 billion to develop two types of central switches and North America $3.5 billion for four such systems, Europe dished out $6.7 billion for no fewer than nine different switches. "That is no way to achieve the economy of scale that Europe needs to stay competitive," English says. "Europe's got to get its act together if it wants to stay in the communications business."

RACE's goal is to help reverse these trends. Its thrust is to establish a strong, if not leading, position for its telecom manufacturers in broadband markets around the world. At stake at home is a market that could exceed $500 billion by the year 2000. Of the total figure, about two thirds is for terminals and related equipment and one third for networks, switches, and the communication infrastructure.

PICTURE PHONES GET A NEW IMAGE

TODAY'S TECHNOLOGY BRIGHTENS COMMERCIAL INTEREST

by Wesley R. Iversen



COLORFUL. Widcom's $17,500 Personal Video Station can transmit color video and still pictures.

CHICAGO

Picture phones have long been the fascinating stuff of science fiction, even before Spock and Captain Kirk talked eyeball to eyeball with the evil Klingons on *Star Trek*. But despite years of lofty predictions and AT&T Co.'s promotion of a moving picture phone 21 years ago at the 1964 World's Fair in New York, these neat gadgets never took off commercially.

Their story could be changing. Some industry proponents of the picture phone contend that a convergence of a number of technology trends is about to fuel the industry's long-awaited launch.

Business users are the first target. The ability to send compressed, digitally encoded TV signals over newly available and relatively low-cost switched 56-kb/s phone lines is spawning a wave of entrepreneurial startups. None of the companies seems to have solid projections on how large the picture phone market might be. But amid heady talk of placing a picture phone on every office desk, all agree that the potential is huge.

Even as 56-kb/s, full-motion picture-phone systems for the desktop are drawing plenty of attention, other approaches, including the use of higher quality phones, are still being pushed. There is also a contingent of dissidents who contend that freeze-frame picture phones are the best way to bring low-cost teleconferencing into the office (see "Freeze-frame conferencing: a better way?" opposite, and related story, p. 34).

The most enthusiastic proponents of picture phones even contend that precipitously falling hardware prices driven by very large-scale integration, transmission-technology advances, and volume production could soon propel the picture phone into the home.

"Inevitably, it will reach a point—and we're talking five years, maybe—where every home user will have it, just like a television set. There's no doubt that it's going to happen," says Arnold E. Seigel, executive vice president of Avelex, a Lanham, Md., company that plans to introduce a 56-kb/s video codec next year for use with full-motion picture phones.

Others, however, aren't so sure. "Once again, I'm afraid that we may be seeing the technologists pushing us along to try and come up with applications for a toy they've developed," maintains Elliot M. Gold, president of Telespan Publishing Corp., an Altadena, Calif., research and publishing company. "If you look at the way that [picture-phone] market failures have occurred in the past, a lot of it came from a technical push where some engineers came up with a neat idea, and there was never any market for it."

Doubts aside, Gold observes that "there's a very odd thing going on. Companies are getting funding for these desktop picture telephones."

For example, in the face of the sour venture capital market, Pictel Corp., a video codec and picture telephone startup, was able to raise a tidy $4.2 million by going public last November, three months after the Peabody, Mass., company's founding.

Fledgling Avelex has attracted private funding—more than $1 million to date—from sports and entertainment figure Abe Pollin, who is the majority owner of the Washington Bullets and Capitals professional basketball and hockey teams and the Capital Centre arena in Landover, Md. "He [Pollin] got hooked on the technology when he heard about the prospects for a phone in every house," Seigel reports.

One key trend that is fueling much of the current picture phone enthusiasm is the emerging availability of switched 56-kb/s service. AT&T plans to have 34 U.S. cities tied into its new Accunet Switched 56 network by year end and will add 36 more next year.

Satellite Business Systems, McLean, Va., the IBM subsidiary being sold to MCI Communications Corp., and Argo Communications Corp., New Rochelle, N.Y., are also racing to expand newly launched 56-kb/s networks. In addition, local telephone companies are filing rapidly for state tariffs to offer the new digital service.

"What this means is that for the first time you can have dial-up 56-kb/s video-communication service right into your office in the same way that you have normal phone service now," explains Larry Levy, national sales manager for Widcom Inc., a Campbell, Calif., company that makes the only 56-kb/s video codec now on the market.

CHEAPER ALTERNATIVE. At $48 an hour, AT&T's Accunet will be significantly cheaper than the T1 (1.544-Mb/s) carriers typically used for dedicated room-to-room teleconferencing today. Time on T1 lines must be reserved in advance, and the cost can run from $740 to $1,100 an hour, Levy says.

A dedicated point-to-point 56-kb/s line is another option. But as with the T1 service, the user must go to a special room, many times in another building or across town, and the cost of a dedicated 56-kb/s line can run into many thousands of dollars per month, Levy adds.

The availability of dial-up 56-kb/s service has sparked a race to develop the video codecs that are needed to make 56-kb/s full-motion video telephony possible. Key is the algorithm that compresses the 4.2-MHz video output signal from a camera (equivalent to about 90 Mb/s after digitization) down to a 56-kb/s digital signal for transmission. It's a nontrivial task, as those in the industry are fond of saying.

Widcom offers its product based on an algorithm that admittedly delivers picture quality far lower than that of other, higher-speed services. Motion is blurred and sometimes jerky. But Widcom has so far shipped more than 70 of its $56,000 codecs, says Levy. Most have gone to businesses that use dedicated 56-kb/s lines and provide their own cameras and monitors.

Widcom is working on advanced algorithm enhancements for better picture quality. This month, the company plans first shipments of its new picture phone designed to work with its codec. Known as the Personal Video Station, the telephone comes with two 7-in. color monitors and a built-in camera; it has a second vertically mounted camera and

FREEZE-FRAME CONFERENCING: A BETTER WAY?

Low-cost full-motion teleconferencing may be where the glamour is, but industry watchers are betting that freeze-frame teleconferencing is where the market volume is, at least in the near term. Companies can offer these services at an even lower price than switched 56-kb/s full-motion video because they are transmitted over regular voice-grade phone lines.

"People talk a lot about wanting to see the other person. But what do they do when they're at a meeting? They look at documents, graphs, and charts," says Elliot Gold, president of research company Telespan Publishing Corp. "I think the smart money in teleconferencing is with these companies that provide you a quick, cheap look at visuals."

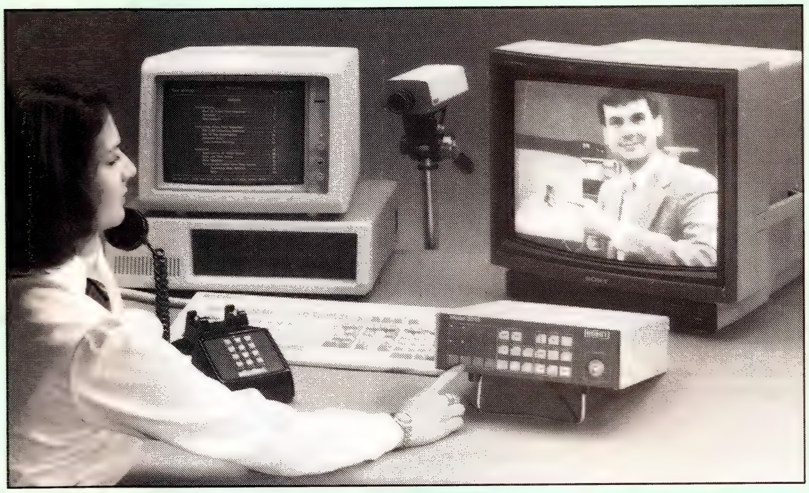
One company planning to do just that is Image Data Corp., with its freeze-frame Photophone (see story, p. 34). But the Datapoint Corp. spin-off could run into plenty of competition. Some think that heavyweights such as IBM Corp. and AT&T Co. may jump in with freeze-frame teleconferencing add-ons for personal computers. "Initially, that's what videoconferencing is going to be like at the desk. The less than $1,500 add-on is going to be the precursor to full motion [at the desk]," says Gold. He adds that Image Data's Photophone "is cute. But it doesn't make a lot of sense because that's all it does."

An AT&T representative denies reports that the company is working on a freeze-frame picture-phone add-on for its PC6300 personal computer. At IBM, a spokesman confirms that some of its customers have tested the company's internal freeze-frame teleconferencing system. But he contends the system is not likely to become a commercial product.

The market for freeze-frame equipment now amounts to only about $10 million to $15 million annually, and might therefore be too small for firms such as IBM to enter, says Fredrick Sammis, sales engineer at Robot Research Inc., San Diego. Founded as a robot-vision-system company in 1969, Robot Research migrated to slow-scan video equipment and has been been selling picture-phone equipment for 10 years. It claims to be the largest volume producer in a once-sleepy business that Sammis says has accelerated suddenly to a 25% to 30% annual growth rate over the past couple of years.

This month, Robot Research will introduce a significant upgrade to its product line, adding higher black and white resolution and transmission speed, as well as what's billed as "the first stand-alone video transceiver capable of transmitting color pictures over [ordinary] telephone lines." The new 3010 series will consist of two models. At $4,990, the model 3012 can transmit black and white images with a resolution of 256 pixels by 256 lines and 64 gray-scale levels in 8 or 16 seconds, depending upon the mode selected. The slower mode is used when there are difficulties transmitting at the faster speed. Images of 512-by-480 resolution can be sent in 35 or 70 seconds.

The new Robot Research model 3013, priced at $6,990, sports the same black and white capabilities but adds color; 64 gray-scale levels translate to 262,144 color shades, Sammis says. The 3013 will transmit color images with a resolution of 256 by 240 in 13 or 26 seconds, while 256-by-480 pictures can be sent in 26 or 52 seconds. –W. R. I.



NEW WAVE. Robot Research Inc.'s model 3013 offers color freeze-frame video.

DIFFERENT. Datapoint Corp.'s Minx (Multimedia Information Network Exchange), a full-motion color video work station, is designed for a campus environment over a broadband LAN.

stand for transmitting still pictures that range in size from 35-mm slides to 8½-by-11-in. prints.

The unit will sell for $17,500. What's more, Levy says that Widcom has arranged a "co-marketing agreement" with AT&T. According to the agreement, Widcom equipment will be placed in AT&T Customer Presentation Centers around the country.

READY TO SHIP. Though Widcom was first out of the box with its codec, Avelex says it plans to ship its 56-kb/s codec during the first quarter next year. And Pictel isn't far behind, with plans to ship its codec around the end of the second quarter. Both companies claim to have developed proprietary algorithms superior to Widcom's that will offer much better picture quality, and both plan to price their codecs in the $50,000 range.

Pictel is also expected to offer a picture phone and a local-area network to allow multiple phones to share its codec. Avelex initially will not offer a picture phone, instead concentrating on its codec, which will offer selectable bit rates ranging from T1 speeds to 19.2 kb/s. (The latter rate would be sufficient to transmit a video-only signal, Seigel says, though of noticeably low quality.)

Also lurking in the wings is NEC America Inc., which is working on a 56-kb/s video codec and picture phone, but has been slow in bringing the product to market.

Meanwhile, a project group of the American National Standards Institute's T1Y1 committee has started developing standards for subrate (below T1) video codecs, including standards for 56-kb/s transmission (in Europe, the corresponding rate is 64 kb/s). Given the different algorithmic approaches of Widcom, Avelex, Pictel, and perhaps others, a multiple U. S. standard is a possibility, concedes David Crawford, a Bell Communications Research Inc. employee who heads up the T1Y1 project effort.

AT&T closing last of its public conferencing rooms

On the international front, Crawford reports that members of the International Telegraph and Telephone Consultative Committee (CCITT) standards organization "are very keen on coming up with a single, worldwide standard" for 56-kb/s (64-kb/s) codecs.

One company that is taking a different approach to bringing full-motion video communication to the office is Datapoint Corp. The troubled San Antonio, Texas, office-automation company recently rolled out a full-color picture phone designed primarily for a campus environment over a broadband LAN.

Known as MINX (for Multimedia Information Network Exchange), the product features an $11,500 work station with built-in monitors and cameras. The station doubles as a computer or a teleconferencing terminal.

The MINX video signal runs at 10 MHz on the broadband network and could be piped outside the LAN for phone-line transmission using a 56-kb/s video codec. But picture quality outside the LAN environment would be low, warns Neal Tompkins, Datapoint's research and development director.

For its part, AT&T has met failure with its Picturephone Meeting Service public videoconferencing rooms, which it set up starting in 1983 in 11 U. S. cities. "The centers didn't generate the kind of revenue we expected," concedes an AT&T representative. AT&T says that it will shut down the last of the rooms next month.

The phone giant is continuing to push full-motion video teleconferencing using T1 carriers, however, though with a different approach. Despite the failure of the public rooms, they did prove a strong vehicle for familiarizing corporate America with the concept, an AT&T representative maintains. The company is now promoting the service for private business use, and some hotel chains are also offering T1 meeting-room service. According to Telespan's Gold, several hundred dedicated teleconferencing rooms were installed in the U. S. last year, more than in the previous three years combined.

This spring, AT&T also introduced a full-motion system known as Vivid, which is designed for switched teleconferencing on fiber-optic lines and other carriers at a rate of 45 Mb/s. Vivid is aimed mainly at large corporate users that have multiple sites within a 100- to 200-mile radius and already use 45-Mb/s fiber-optic cables.

VIVID SIGNALS. Under Vivid, an AT&T codec called the DBT-45 digitizes, encodes, and compresses the video signal from a standard camera. It also digitizes and encodes the audio signal, and then multiplexes video, audio, and data into a single 45-Mb/s data stream. A unit at the receiving end reverses the process. A wideband video switch at an AT&T central office routes the signal appropriately, with each switch handling up to 24 sites in a given metropolitan area. Not including monitors and camera, the cost per site for Vivid users amounts to between $40,000 and $50,000.

The new AT&T system produces "really super-quality television, as good or better than anything I've seen on cable," says Paul Robinson, Vivid Teleconferencing program manager. As with the higher-speed T1 carrier services, however, Vivid transmission costs will be significantly higher than systems designed for use with 56-kb/s lines. ☐

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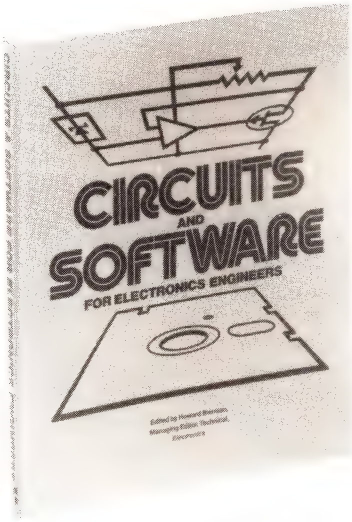

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PICTURE PHONE CUTS TIME AND COST IN TELECONFERENCING

DESKTOP SYSTEM SENDS SINGLE FRAMES OVER UNCONDITIONED LINES

TECHNOLOGY TO WATCH is a regular feature of *Electronics* aimed at providing readers with exclusive, in-depth reports from companies around the world on important technical innovations. It covers significant technology, processes, or developments incorporated in major new products. The reports also provide analyses of technical data, so that readers can assess the impact of new developments. Gerard Cullen and David Monroe, founders of Image Data Corp., San Antonio, Texas, conceived and developed the Photophone system described here.

A mixture of frame-grabbing technology and a compression algorithm that chops the number of bits per pixel from 7 to between 1.2 to 3.5 are the muscle in a low-cost, easy-to-use desktop teleconferencing system. With a price of $8,850 per unit, the Photophone from Image Data Corp is considerably less expensive than most teleconferencing setups, and it can use standard telephone lines where many other systems require costly dedicated lines.

But its developers say price is not its only claim to fame. They say its real strength lies in the simplicity of the user interface. Photophone was designed to be easy to set up and to use—but not expensive to build, since the Image Data Corp. design team opted for standard parts rather than custom chips. Their design ingenuity went, instead, into the software effort, notably the compression algorithm.

Introduced at the spring International Communications Association Conference in Dallas, Photophone is just now beginning to be shipped in volume. It resembles a rotund personal computer with an articulated camera-carrying arm (Fig. 1) and can send a monochrome single-frame image of 196 by 122 pixels with 128 levels of gray scale in just 7 to 12 seconds. The system can transmit higher-resolution images, such as engineering drawings, of 296 by 440 pixels in just 12 to 20 s.

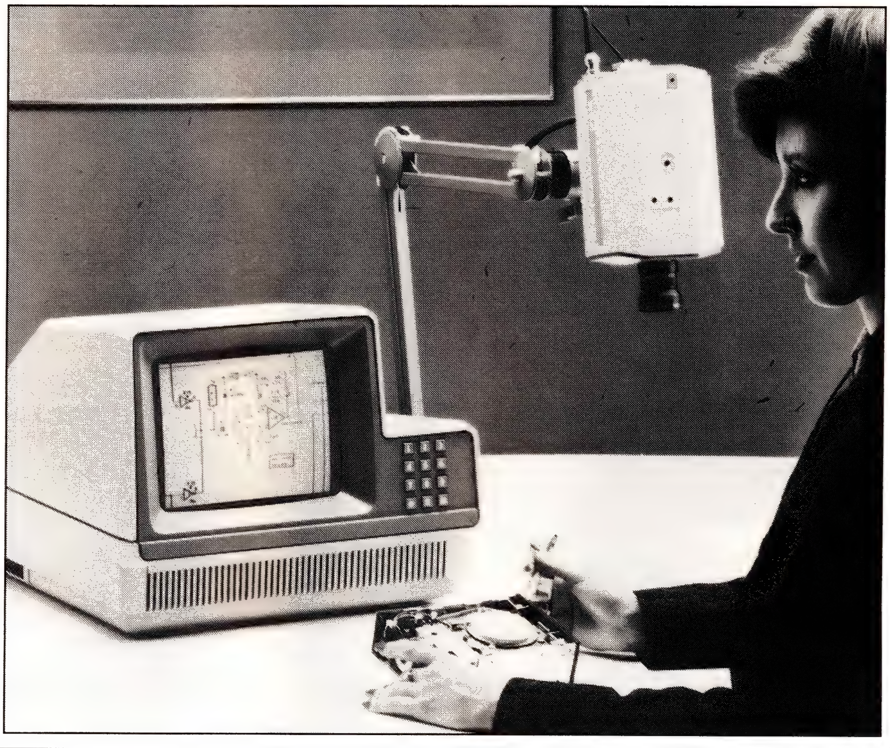
Although teleconferencing has been talked up for more than two decades, it has never blossomed in the marketplace. Bell Telephone Laboratories showed off an experimental telephone that simultaneously transmitted voice and full-motion images over phone lines in its 1964 New York World's Fair debut, but the Picturephone never took off. Expensive dedicated leased lines kept it beyond the reach of residential users. And teleconferencing centers, developed for the business community, failed to attract a following. However, a number of recent developments promise to inject new vigor in full-motion teleconferencing (see related story, p. 30.)

Besides the high cost of connection time, the inconvenience of travel to a teleconferencing center or the expense of building and maintaining an in-house teleconferencing studio has kept teleconferencing from fulfilling the promise of the early Picturephone, says Gerard Cullen, one of the founders of Image Data and now its vice president of sales. Cullen says that setting up a top-drawer live-action teleconferencing studio can cost as much as $250,000, and connection time ranges from $1,000 to $1,500 per hour for a T1 trunk. At the low end, slow-scan teleconferencing is much less costly, but it often needs two telephone lines and takes 45 s to transmit an image—and the user interface tends to be complicated to use.

Getting the Photophone to sit on a desk and look like a personal computer meant a lot of work for Image Data, but the company expects the unit's familiar appearance and accessibility to everyone in an office to translate into sales volume. Cullen says the biggest advantage that Photophone has over competing teleconferencing systems is that it eliminates the psychological barriers of voice and image transmission.

"In the early days of teleconferencing, it was freewheeling and wide open, but the early experimentation gave way to a formalization that proved stifling—the medium became the message," he explains. "If the guys who were doing the presenting didn't look like and speak like TV anchormen, people thought they were getting shortchanged. The entire psychology of teleconferencing backfired."

Convinced that teleconferencing technology had missed the boat, Cullen enlisted key personnel—some from his days at Datapoint Corp. (see "Photophone gets a big Texas boost," p. 36)—and began formalizing a design concept. "I wrote the original design specification, and all it said was make it com-



1. PICTURE PERFECT. Photophone transmits freeze-frame images over regular phone lines in just a few seconds.

pact, fast, and work on regular telephone lines," chortles Cullen, recollecting that turning the specification into a product took almost two and a half years.

Although the compression algorithm is the single most notable technological contribution of Photophone, "the real innovation is in the design of the interface, making all the parts play together in a reliable way," points out Richard Berlint, Image Data software engineer.

Setup time is negligible. Once the user links the telephone handset connection to the Photophone with an RJ-11 jack and places the Photophone's telephone and power cable in their proper receptacles, it is ready to use.

After placing a call to a receiving station, the operator aims the camera by moving it on its extendable arm. The user can transmit images immediately or store them in memory. For example, to transmit live action, the user points the camera at an object, brings the image into focus on the display, and then punches the Send button to hold and transmit the frame. Alternatively, the user can store up to 20 images in memory, bring them up onto the display, and then transmit them. During the short interval in which the system is compressing and transmitting the image, voice communication is interrupted.

Avoiding a common pitfall of startups, Image Data eschewed custom integrated-circuit technology in favor of off-the-shelf large-scale-integration and very-large-scale-integration hardware. The bulk of the intensive design effort went into developing integration at the board level (Fig. 2).

TWENTY FRAMES OF STORAGE

An 80188 processor controls an 8-bit system bus, although early prototypes used an 8088. For storing compressed video images for transmission, the company is shipping 256-K bytes of central random-access memory with each unit. A total of 512-K bytes could be made available in the future, making it possible to increase the typical image storage from the standard 20 frames to 40. The digital video subsystem, which contains digital-to-analog and analog-to-digital converters as well as 128-K bytes of internal RAM, refreshes the monitor and holds the uncompressed images; 64-K bytes of read-only memory contain the complete program code. Three chips make up the telephone-interface subsystem, and cartridge memory is included as a handy means to distribute future upgrades.

The Photophone's key technology is the algorithm to compress the stored video for transmission over ordinary phone lines. "During the year and a half that the image-compression technology was under development, a number of compression-algorithm candidates were developed in C, then statistically evaluated for robustness and efficiency until a balance was struck between picture quality, compression-decompression time, and transmission time," explains Berlint.

The 80188 controls compression. It extracts the digitized image from the digital video-system memory, reduces the number of bits required to represent the image, and stores the compressed form in control RAM. To eliminate motion jitter, an interlace filter averages two interlaced 296-by-440-pixel frames, creating a single 296-by-220-pixel image.

The pixel data is then processed through a two-dimensional differential-pulse-code-modulated (DPCM) filter. With this technique, the DCPM algorithm predicts a pixel's value on the basis of the difference between the value of pixels immediately above and immediately to the left of the target pixel.

The Image Data design team spent long hours developing a quantizer that could reduce the 7-bit-per-pixel information from the DPCM filter to a 4-bit-per-pixel output. Only after considerable tuning did the designers develop an algorithm that produced an image of acceptable quality over the range of errors predicted by the DPCM filter.

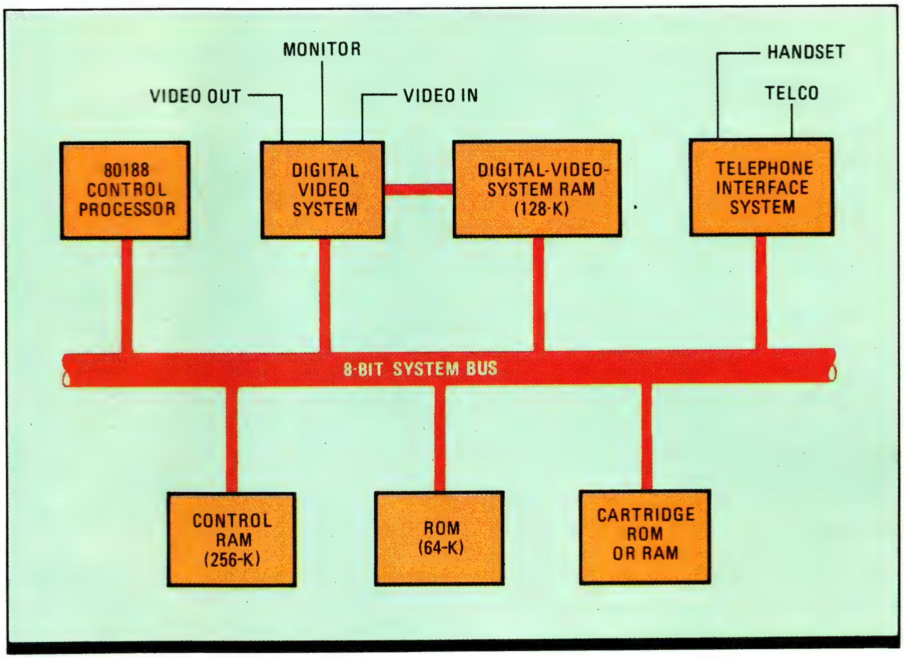
"The trick is to find something that works well over a larger class of pictures," says Paul Nietfeld, the engineer who was responsible for image compression. "It took almost a year and a half to develop the algorithm for the quantizer."

Considerable effort also went into developing a coder that could reduce the 4-bit-per-pixel output of the quantizer to 1.2 to 3.5 bits. After lengthy statistical analysis, the designers developed a hybrid algorithm that combines the speed of run-length coding with the statistical rigor of Huffman coders (without irregular block length).

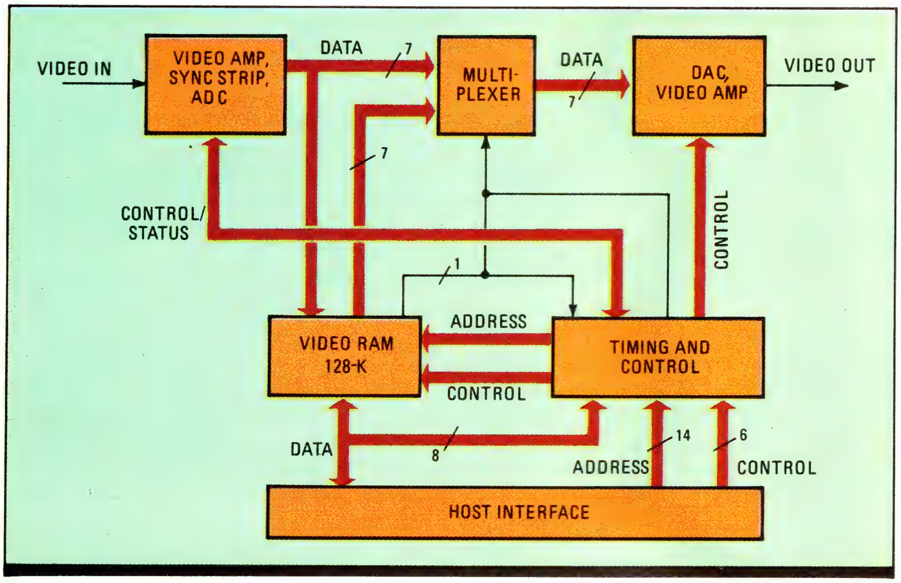
The compressed image data is stored in control RAM and then transmitted through the telephone-interface subsystem. The Image Data group built this subsystem around Rockwell International Corp.'s R96 FAX 9,600-bits-per-second modem—a three-chip VLSI set that conforms to the International Telegraph and Telephone Consultative Committee's Group III facsimile standard. The central processing unit can reconfigure both an analog front end that has switched-capacitor filters and a microprogrammed baud- and data-rate modem to handle all important communications chores. For example, if the 80188 detects poor line quality from the modem, it can compensate by changing the rate to 7,200 or 4,800 b/s.

The telephone interface also contains a telephone-line coupling transformer, a dual-tone multiple-frequency tone generator, and a switch for toggling between data and voice transmissions, all under control of the 80188. One status bit in the telephone-interface subsystem detects on- or off-hook conditions; another detects ringing and enables the system's auto-answer feature.

The digital video-system interface to the outside world is compatible with the National Television Standards Committee's Standard RS-170 (Fig. 3). During local refresh, 592 7-bit



2. BOARD-LEVEL INTEGRATION. Merchant parts keep costs down, giving Photophone an edge over pricey teleconferencing technology. Intel Corp.'s 80188 processor controls the bus while Rockwell Corp.'s R96 FAX modem supports the telephone interface.



3. VIDEO SUBSYSTEM. After compression, up to 20 images can be stored in the video subsystem's RAM for transmission.

samples per line pass from the ADC to the digital-video-system RAM and then to the DAC and the video out. When the 80188 requests a freeze frame, the data does not go to the video out; instead, the system compresses it, and the control RAM stores the results so that the telephone-interface system can transmit them later. To pump up the transmission rate, the Photophone designers overlapped compression, transmission, and decompression operations.

Before transmission, a 16-bit cyclic redundancy check is run on every 512-byte block of transmitted data looking for errors. The system retransmits any 512-byte block that contains errors. As a result, the picture sent and the picture received are identical—there is no degradation.

The software-development project was manageable, says Berlint, only because it was written in C, a high-level language known for its portability. "This enabled us to quickly prototype, test, and verify user-interface options, then pick only the best one."

Given the simplicity of its user interface, it is easy to imagine Photophone in a home, even though its current price will probably keep it beyond the reach of most private customers. But Image Data hints that there has been some discussion of a single-board version of Photophone that can work with a personal computer. ☐

COMPANIES

PHOTOPHONE GETS A BIG TEXAS BOOST

San Antonio is better known for rearing cattle than for communications startups, so no one was more surprised than Image Data Corp.'s founders to discover local investors ready to fork over 95% of the money needed for first-round financing.

After nervous months spent drawing engineering specifications and writing a business plan, founders Gerard Cullen and David Monroe were ready to go public with their idea in spring 1983, but they figured they would have to sell their concept outside central Texas to attract serious interest. But they were wrong.

"Henry Cisneros, the young mayor of San Antonio, hosted a party to get the ball rolling," remembers Cullen. "Some local folks drove up in an old Oldsmobile, listened quietly to the presentation, then gave us a sizable check and a wish for good luck." It was signed by a member of the King Ranch family. Cullen believes civic pride in a home-grown high-tech startup prompted some family members to invest.

Help also came from such seasoned high-tech investors as Vince Prothro, a founder and former president of Mostek Corp. now associated with Southwest Enterprise Associates, Dallas; Mike Faherty, former chief executive officer of Datapoint Corp.; and Michael Bell, an early investor in Apple Computer Inc. and Amp Inc.

The initial offering, structured as a $660,000 research and development tax partnership, allowed investors to write off 95% of the investment associated with research as long as it was done before the start of actual development work. "Our investors knew all about the failure of the Picturephone and understood that this was a high-equity high-risk development effort. But they also knew that new technology could mean a big payoff," says Cullen.

The Photophone story really began in 1980 when Cullen, then a marketing vice president at Datapoint, got an inkling of the potential of teleconferencing technology. "The company was looking at ways to expand their office-automation offerings and were experimenting with coaxial-cable image transmission. It opened my eyes to the office-automation potential of teleconferencing."

Cullen became a regular at teleconferencing seminars, but it wasn't until he heard a speaker from IBM Corp. tell about how his colleagues were picking

PICTURE THIS. Software engineer Richard Berlint (left) and Image Data cofounder Gerard Cullen say the frame-grabbing Photophone will boost office teleconferencing.

office locks to get access to an internally produced freeze-frame transmission system that he became a true believer.

Confident that freeze-frame technology was the answer to teleconferencing, Cullen turned to David Monroe, a fellow Datapoint R&D development engineer who had worked on compression techniques in laser printers and graphics products for the office.

"Most of the smart guys I know were working with computers," Cullen recalls, "but the state of the art in freeze-frame was still mired in first-generation analog technology. I convinced Monroe that if the smart guys push the technology, we'll get a pull from the market void that will put us way ahead of everyone else."

The way Cullen tells it, the decision to cut the ties to Datapoint early in 1983 and launch the new venture was easy. "Ed Gistaro [Datapoint's president] got wind of our conversations. He told us we had a good idea, wished us luck, and told us to start right away—without cleaning out our desks. If he hadn't done that, I don't know if we would have started."

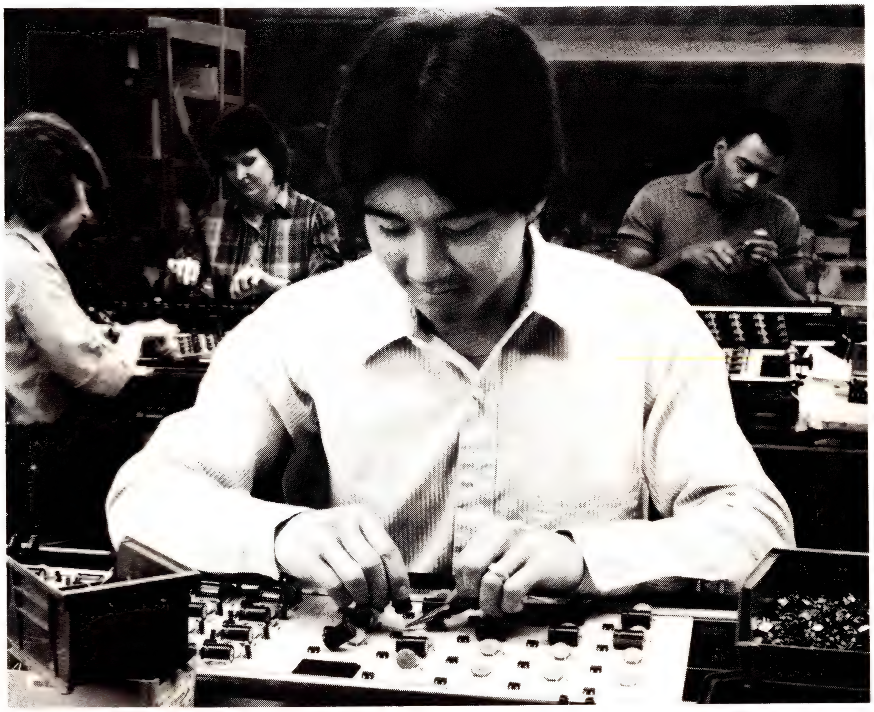
BUILDING THE PROTOTYPE. For the next three months, Cullen and Monroe supported themselves and their families with savings and Datapoint severence pay while they developed the plans that paid off in first-round financing. Buoyed by fresh capital and the confidence of their backers, they enlisted software engineer Richard Berlint to develop the all-important user interface. Berlint, a boyhood friend of Cullen, had left Western Electric Co.'s facility at Sandia National Laboratories, Albuquerque, N.M., to join Datapoint and then followed his friend to Image Data. Together, the three settled down to build a prototype.

By last summer, they had a working model to show, but it turned out to be far from a finished product. By putting functionality before simplicity, the wrapped-wire machine needed too many parts to manufacture efficiently.

'This was a high-risk high-equity development effort'

Fortunately, Image Data could by now call on the expertise of two more ex-Datapoint officers to lead the redesign: Harry Pyle, senior vice president of R&D at Datapoint and one of the inventors of Arcnet, and Victor Poor, Datapoint executive vice president and now president of Image Data. Seven months after the redesign began, Photophone made its debut at this year's International Communications Association show in Dallas. *–Robert Rosenberg*

Kelly announces a "first" in the testing of light industrial temporaries:



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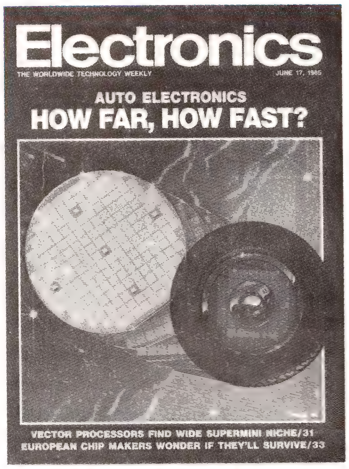

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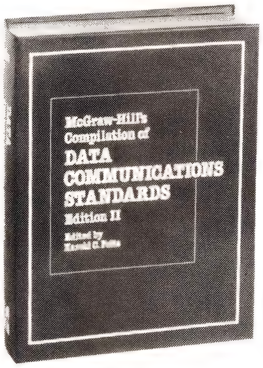
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ELV

REAL-TIME OP SYSTEMS JOIN THE COMPUTING MAINSTREAM

GENERAL-PURPOSE SOFTWARE BRINGS EXPERT POWER TO NOVICES

by *Alexander Wolfe*

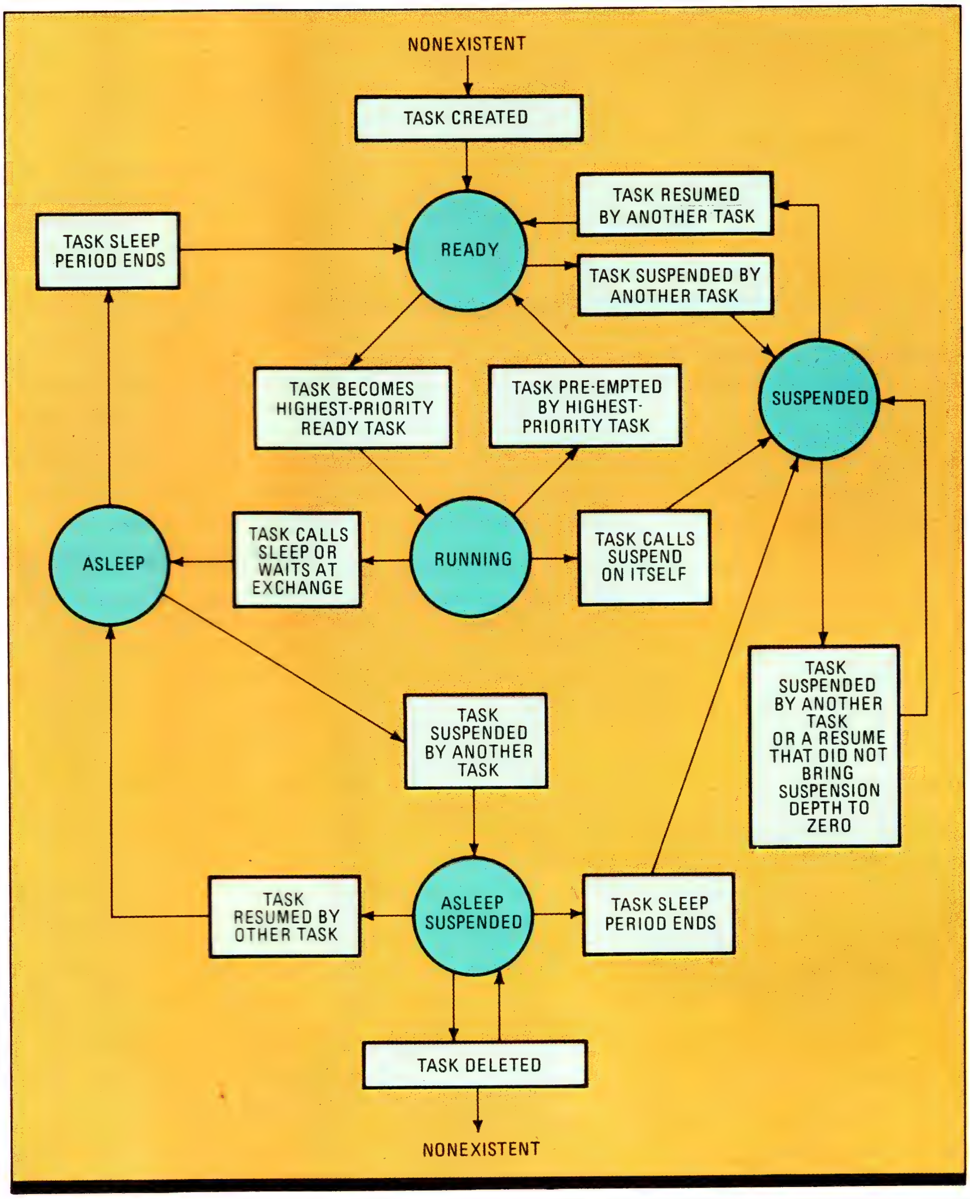
Real-time operating systems, those complex software programs that oversee fast-response systems, are adding features aimed at bringing expert computing power to users who have little experience with sophisticated machines. A host of these operating systems, as well as new applications designed to handle increasingly complex real-time processes, is scheduled to come onto the market during the next few months.

At the same time, real time is breaking away from its traditional base in high-end defense applications. The boom in 8-, 16-, and now 32-bit microprocessors has brought real time into the commercial realms of the automobile, factory floor, and laboratory, usually as embedded systems. Specialized software houses appear to be leading the real-time revolution with the larger computer manufacturers also joining in (see table, p. 45), and the applications developers following closely.

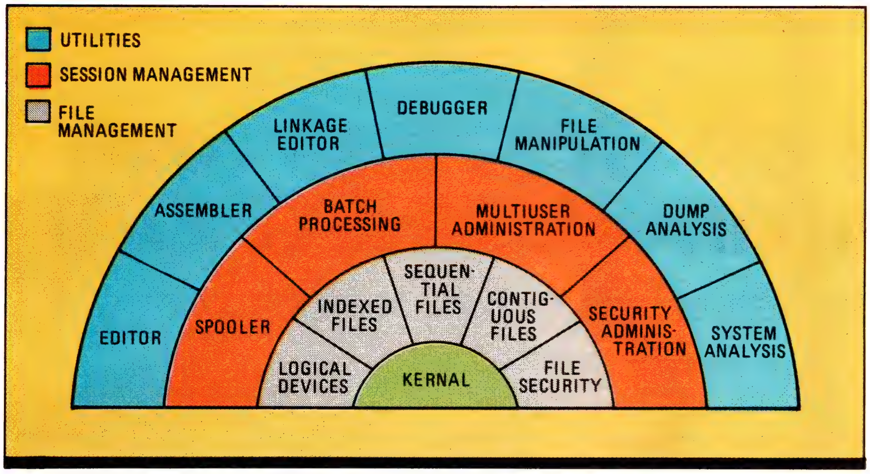
However, as the stage gets set for real time to proliferate, the number of engineers experienced in the fine points of real-time design has failed to increase. In the near term, at least, the technology's capabilities may outstrip the electronics industry's ability to apply them. Manufacturers are tackling this potential stumbling block by offering general-purpose, off-the-shelf products that are easily customized through the use of interactive menus.

Briefly, a real-time system responds to events as they occur. Unfortunately, these events rarely take place in a predictable fashion. Moreover, in the real world, multiple stimuli—such as the movement of a robot's arm, completion of a transaction, a sensor's data waiting for loading—will generate software interrupts in a catch-as-catch-can fashion. Typically, each interrupt will require unique processing, which is usually handled by separate service programs.

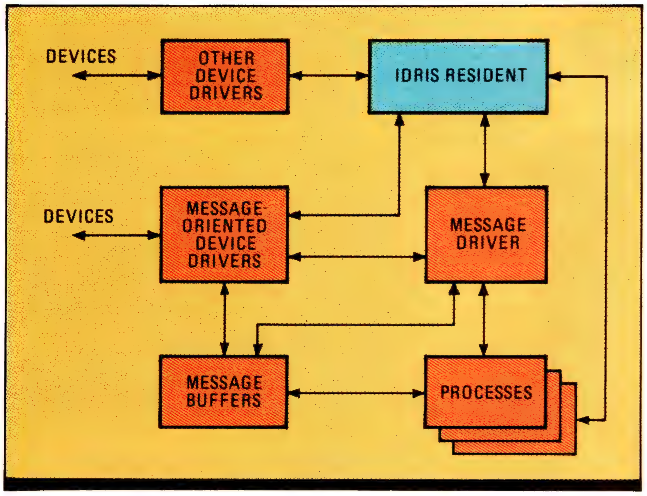
Unlike typical time-sharing schemes, real-time service programs are not allocated fixed blocks of time for execution in a round-robin fashion. Real time is undemocratic: external events and their associated service routines are prioritized. The highest-priority active interrupt takes control of the system. Its service program runs until completion or until another, higher-priority interrupt comes along and bumps it. In that case, this new routine executes, and then the bumped pro-


NONEXISTENT
TASK CREATED
READY
TASK RESUMED BY ANOTHER TASK
TASK SLEEP PERIOD ENDS
TASK SUSPENDED BY ANOTHER TASK
TASK BECOMES HIGHEST-PRIORITY READY TASK
TASK PRE-EMPTED BY HIGHEST-PRIORITY TASK
SUSPENDED
ASLEEP
TASK CALLS SLEEP OR WAITS AT EXCHANGE
RUNNING
TASK CALLS SUSPEND ON ITSELF
TASK SUSPENDED BY ANOTHER TASK OR A RESUME THAT DID NOT BRING SUSPENSION DEPTH TO ZERO
TASK SUSPENDED BY ANOTHER TASK
TASK RESUMED BY OTHER TASK
ASLEEP SUSPENDED
TASK SLEEP PERIOD ENDS
TASK DELETED
NONEXISTENT

1. STEADY STATE. The highest-priority interrupt takes control of a real-time system. Current processing is suspended, the new interrupt service routine or task is activated and continues until the task ends.



2. GLOBAL VIEW. At the heart of an operating system lies its executive, or kernel. Outer layers consist of broader control-file and session-management functions, and utility programs.



3. PROCESS TALK. An Idris enhancement, the Interprocess Communications Package, will store, synchronize, and pass messages between processes over a wideband channel.

gram gets reactivated to finish up. Technically, this is often called concurrent processing, even though only one program is running at any one instant. The process is illustrated with a task-state diagram, where the tasks correspond to interrupt service routines (Fig. 1).

These interrupt-handling manipulations constitute the heart of a real-time operating system, usually dubbed the scheduler or task manager. Thus interrupt-service management, along with memory allocation and management, task-state and event control, and task synchronization, form the operating system's nucleus, known as a kernel.

Kernels are often sold separately for embedded-applications users seeking only basic functions. In a fully implemented operating system, powerful global software tools lie atop the kernel. Generally, this outer shell consists of two layers. First come file-management facilities and multiuser handling. Utility programs (which are not always strictly considered part of an operating system) such as editors, assemblers, and linkers are farthest away (Fig. 2).

Off-the-shelf operating systems become part of working applications when they are installed in hardware along with user-written applications programs. In large part, the applications program is really a collection of interrupt service routines. (There is an important distinction: Interrupt service management, though part of the operating system, simply directs control of the interrupts to the individual interrupt service routines. These routines are outside the operating system in the applications program.)

Successful navigation of the intricacies of concurrent processing is necessary, although in itself insufficient, for true real-time performance. Throughput is a system's most critical factor.

Allan Wallack, vice president of marketing at Masschusetts Computer Corp., Westford, Mass., a maker of engineering work stations and computers for scientific applications, notes that with standard applications, when throughput lags behind predictions, the user simply waits a little longer for output data.

But in real time, processing will back up. The system, unable to keep up with new input data, will "cave in." So when systems touted for real time don't live up to their claim, "I get my machine back because the customer can't do his job," says Wallack.

But in the real world, it turns out that some systems need to be more real-time than others. An automated jamming system on a military aircraft, for example, is a critical application. It must acquire data from dozens of enemy radars; if the system can't compute quickly enough, it cannot effectively jam the enemy radar, and the aircraft might get shot down. A financial-transaction system, on the other hand, may not involve life and death, but slow processing can cost thousands of dollars.

The simplest applications may be such real-time jobs as ignition control in automobiles. But even here, failure to respond to input data within milliseconds can have negative consequences—for example, if a computer-controlled ignition system suddenly failed on a car doing 50 mph. So real-time systems are always on the firing line, regardless of the applications they are serving.

"Real-time systems have a broad spectrum, from what we call 'radar ranges' at one end, to robots with central controllers and central data bases at the other," says P. J. Plauger, president of Whitesmiths Ltd., Concord, Mass. Notes Elizabeth D. Rather, president of Forth Inc., Hermosa Beach, Calif., "Robotics is probably the fastest-growing applications area in the industry now."

APPLICATIONS ADVANCING

Some of the latest advances in real-time operating systems come from these areas. Large-scale computer systems dependent on data communications are on the leading edge.

The Missing Link is a new software-applications generator aimed at this market. It is offered by Multi Soft Inc., a recently formed subsidiary of Multi Solutions Inc., Lawrenceville, N. J. Billed as a personal-computer-based mainframe-integration product, the software offloads the processing usually handled by a mainframe to personal-computer-based terminals. The package ties in with and executes operating-system-like functions. The personal machines-cum-terminals can perform as more than simply glorified data gatherers, freeing up the mainframe for higher-level tasks.

The concept arose from a project that Multi Soft's president, Martin Edelstein, designed for the Hertz Corp., his previous employer. The company wanted to test a prototype automation system for its customer rental-car service counters at John F. Kennedy International Airport in New York. Edelstein conceived the idea over a weekend and built it during 1984.

"It's almost an obvious approach. The difficulty is the implementation," he says. The finished system, which connects 150 work stations to a Data General Corp. Eclipse superminicomputer, automatically handles rental agreements, accounts receivable, inventory tracking, and associated functions.

Real-time control comes into play through the program's timing smarts. Its ability to track and synchronize the processing going on in both the personal computers and the mainframe is the key. Using tokens—brief messages sent across telephone lines—different software routines executing in physically separate parts of the system can work as part of a single large-scale distributed real-time system.

Multi Soft's Data Operating System, a version of Missing Link, a standard personal-computer control program, will be announced this month. A version based on S1, Multi Solutions' home-grown real-time operating system, will follow in the fourth quarter. The new software divides a standarized set of tasks between mainframe and terminal to implement the process-offloading feature.

Another key feature is 9,600-baud performance over standard nondedicated telephone lines, according to Edelstein. This speeds data transfer; with the offloading, fewer transfers take place, further reducing data-communications costs. "With the S1-based version, not only will you be able to talk to one computer, but you'll be able to talk to any number of computers simultaneously," he claims.

Such distributed applications are likely to become increasingly important. Today's garden-variety real-time operating system isn't up to the complex intercommunications and task-synchronization challenges that such far-flung computer networks pose. Thus researchers aim to develop an entirely new class of real-time operating systems.

Currently, real-time operating systems run multicomputer systems as a network, says Paul Fortier, author of the just-released *Design and Analysis of Real-Time Operating Systems*. Yet they do not exert truly unified control. Each computer has, in effect, its own operating system. Messages sent back and forth between computers transfer status and data, and perform synchronization on a global level. Still, this is not efficient.

"The problem is how to design operating-system software that has limited knowledge of an entire system's state, that can respond based upon the information it knows, and make the proper decisions that affect an entire collection of computers," notes Fortier. Research on these distributed operating systems—which make optimum use of each computer's resources and synchronize tasks on a micro (that is, software module) level—is currently under way in industry and academia. Fortier points to IBM Corp. and Carnegie-Mellon University as two examples.

Less radical operating-system approaches are also aiming to broaden their software horizons. "As computing power becomes more robust, the tendency to solve larger problems within any one application increases," notes Intel Corp. product marketing manager Kathie Norris. "As a result, today's real-time operating system needs to bring a little more to the party than just good interrupt-response time."

INCREASED CAPACITY

Intel is touting its iRMX 286 operating system, introduced this past June, as a major advance over the iRMX 86. The new software is compatible with the company's iAPX 286 microprocessor family. Most significant is its ability to directly address 16 megabytes of memory, as compared with the iRMX 86's 1-megabyte capacity.

This increase should satisfy demand from two quarters, says Norris. Many complex applications breed long programs, and require vast amounts of memory to hold the code. Other newer real-time ventures—private automated-branch-exchange switching and graphics terminals, as two examples—need lots of memory space for data manipulation.

The system can also handle multiple applications as long as memory is limited to 1 megabyte per job. Additional features include hardware traps for error detection, the ability to mark code segments executable-only, and indirect accessing of memory through descriptor table entries.

This tendency to cram added features into real-time operating systems highlights another trend. "Real-time operating systems are beginning to feel more and more general purpose," says Norris. Despite appearances, the new real-time operating systems are not trying to be all things to all people. Rather, manufacturers have a dual goal in mind.

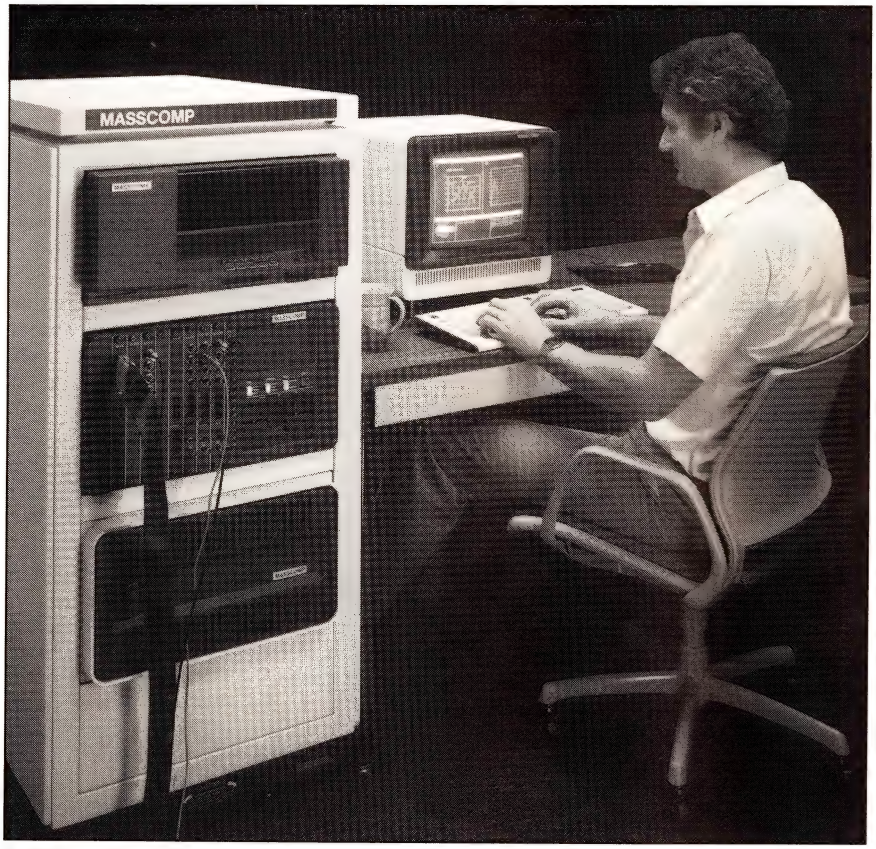
Foremost is encouraging users to purchase off-the-shelf operating systems rather than roll their own with each new project. Embedded-applications developers have been notoriously wary of not-invented-here products. Feature-laden, user-friendly operating systems seek to convert these engineers. At the same time, notes Whitesmith's Plauger, "The make-or-buy line keeps moving toward buy as people get more ambitious with the kind of systems they want. "

The second objective is to ease the transition to real-time for the inexperienced user. Salvation for the neophyte often comes in the form of menu-driven feature selection, or configuration,

4. VIRTUALLY REAL. RTVOS, Harris Corp.'s real-time virtual operating system, runs on the firm's superminicomputers.

design aids. iRMX 286's is called the Interactive Configuration Utility. It presents the user with one or more menu screens corresponding to each layer of the operating system—nearly 60 screens overall. The operating system is configured during a question and answer session. Individual menus handle process management, memory management, descriptors, interrupts, and files. In addition, they allow specification of attributes such as I/O ports, the amount of memory to be used, and device drivers.

The largest single factor in real time continues to be embedded applications, those integral small-scale computer systems hidden in everything from automobiles to consumer applicances. Idris, Whitesmiths' multiuser, multitasking real-time operating system, has been available to embedded-applications developers since 1979. According to president Plauger, Idris was the first non-Bell Laboratories Unix-equivalent system, and is now compatible with Unix System V. "Idris weighs in as the smallest of any real-time system that does file system support that I know of. We've managed to tune for good performance as a result."



5. DATA-INTENSIVE. High-performance machines such as Masscomp's 68000-based MC-500 address data acquisition as a real-time specialty.

The operating system works with 68000 and 8086 microprocessors, and Digital Equipment Corp. PDP-11 and VAX minicomputers. Yet "this [real-time embedded uses] is where the Unix-style architecture is definitely deficient, " says Plauger. Whitesmiths' response was to tailor Idris to run on small machines that have no memory-management hardware, and to provide a deterministic event-driven scheduler. (Unenhanced Unix is nondeterministic: it is difficult to predict the exact time between interrupt occurrence and servicing.)

A major Idris enhancement, the Interprocess Communications Package (Fig. 3) is currently on tap. It is to be available by year's end as an optional Idris add-on (at no additional charge). The package supports a wideband message channel between system processes over a shared data-memory facility. It provides messaging facilities comparable to those offered by Unix and DEC's VMS and RMX operating systems. Idris's resident space requirements increase from about 45 K-bytes to 65 K-bytes with the new package installed.

Embedded-applications designers who have favored Motorola Inc.'s long-popular Versados real-time operating system now have the choice of a new generation. Version 4.4, released this past March, is the latest upgrade to the five-year-old software. According to product marketing manager Ronnie Jobe, a new real-time-tasking enhancement allows the operating system to run with hardware configured without a memory-management unit. This added flexibility is aimed at moving Versados into the industrial-control market, she says.

EMBEDDED APPLICATIONS

Both Versados and its real-time kernel derivative, RMS68K (also version 4.4), are multitasking, supporting embedded applications using MC68000-family microprocessors, as well as Motorola's VMEmodule and Versamodule single-board microcomputers. Versados is a medium-scale package, requiring about 120 K-bytes of resident memory space for operation. Input/outputs, interrupts, commmunications, and utility features are user-configurable, and the operating system uses a unique (that is, non-Unix, non-VMS) command language.

The RMS68K kernel contains only a task controller, intertask communications facility, an initialization function, and an optional memory-management facility. It occupies a lean 18 K-bytes of memory. (Users must code other desired functions by themselves.)

Also of note for these latest releases is streamlined kernel performance. According to Motorola's figures, version 4.4 initiates I/O in 172 μs, a 1.98-times boost over version 4.3. Relinquishing of task control, at 124 μs, is 1.49 times faster than previously. And at 91 μs, context switching—the time required to shift from one task to another—is quicker by a factor of 1.4.

Coming during the first quarter of 1986, says Jobe, is Version 5.5. This upgrade is set to support Motorola's 32-bit 68020 microprocessors, as well as its associated floating-point and memory-management chips, and MVMX 32 hardware.

This time, though, the performance emphasis shifts. "With 4.4, we made the kernel faster. Now we're making the input/output subsystem faster," Jobe says. "We're looking at about 8 to 10 times faster input/output speed."

But Bernard Mushinsky, president of Industrial Programming Inc., Jericho, N. Y., believes that a single-user real-time operating system delivers higher performance in embedded applications. Multiuser handling necessarily slows a system down, he says. His firm's MTOS-UX, which began shipping last June, is available in 68000-, 8086-, and 32000-family versions. In addition, the approach "recognizes the prominence of Unix as a development environment," he says.

The operating system's communications features are noteworthy. The system can communicate with a Unix run-time environment executing on another machine. This feature offers the possibility of distributed control.

MTOS-UX supports up to 16 tightly coupled (that is, tied together on a single VME- or Multibus) central processing units. Its object-oriented control allows rapid response to change in a system's state.

For example, an operating system might sense that a factory process controller's main program should be halted for a diagnostic routine. When both programs are equally complicated, "The things that need to be done are radical—it's not just another path in a program," says Mushinsky. Object orientation facilitates what is, in effect, the complete swap of two huge applications environments.

One embedded-applications-oriented company expanding its approach to the real-time market is Hunter & Ready Inc., Palo Alto. Over the past several years, the firm's VRTX real-time kernel has become popular for Motorola's 68000, Intel's iAPX86 family and 80130, and Zilog's Z8002 and Z80 embedded microprocessor applications. Recently, the company launched a VRTX Device Support Package for the IBM PC/XT. It sees desktop computers as a new frontier for real-time operating systems, although their performance is not comparable to larger machines.

Meanwhile, embedded applications are moving up to larger and more powerful machines. Actually, the term "embedded," has become somewhat corrupted. Manufacturers, who are loath to pass up any chance to pitch a product, are drafting even behemoth computers into the embedded lineup.

SELECTED REAL-TIME OPERATING SYSTEMS

Company	Operating system	Host machine
Data General Corp.	AOS/RT32	Eclipse family
Digital Equipment Corp.	Vaxeln	VAX and Microvax family
Forth Inc.	Polyforth	68000, IBM PC, Novix NC4000
Harris Corp.	RTVOS	H60, H600, H700, H800, H1000, H12000
Hunter & Ready Inc.	VRTX	68000, 8002, 8086, 8031, MIL-STD-1750A
Industrial Programming Inc.	MTOS family	68000, 8086, 8088, IBM PC
Intel Corp.	iRMX 286	iAPX 286
JMI Software Consultants Inc.	C Executive	68000, 8086, 8088, 32000
Masscomp	RTU 2.2	MC500
Motorola Inc.	Versados 4.4, RMS68K 4.4	68000, 68000 VME
Multi Solutions Inc.	S1	General-purpose
Whitesmiths Ltd.	Idris	68000, 8086, PDP-11

Traditionally, embedded real-time systems have been those that are integrated as one component (usually small) of a larger, multifaceted system—for example, a 68000 microprocessor monitoring a car's ignition system. A floor-standing mainframe controlling a laboratory data-acquisition system is not embedded, though it may be dedicated, running only its real-time program.

SUPERMINICOMPUTERS PLAY BOTH ENDS

On the other hand, many of today's newer machines have a foot in both courts. DEC's Microvax I and II, billed as the first microprocessor-level machines in the VAX superminicomputer family, are both powerful and compact. They are now seeing action in embedded, dedicated, and even shared real-time applications.

VMS has become DEC's standard top-flight operating system for the VAX line. To date, however, VMS has not seen wide use for real-time operations. Those laurels have remained with RSX-11M, long synonymous with the PDP-11 machines. Now Vaxeln, a real-time kernel for the Microvax as well as the larger VAX machines, should lead the invasion of these high-performance systems into a wide range of fields, searching for new applications.

Along with an applications-development toolkit, Vaxeln has been on the market for over a year. Still, DEC's PDP-11 is likely to remain the popular workhorse of medium-cost general-purpose real-time applications.

Also due for DEC's VAX-based machines is a new product from Hunter & Ready. The company's Real-Time C language package, released last month, allows development of C language programs in conjunction with the firm's VRTX real-time operating system. The idea is to move real time ahead on the coattails of easy-to-use high-level languages. Says vice president Jim Ready, "The trend for embedded systems is away from operating systems and toward languages to solve [design] problems."

Data General's real-time offering is its AOS/RT32 operating system for the company's 32-bit Eclipse computer line. The software supports multiprocessing, as well as interprocess communications. The AOS/RT32 requires a minimum 64 K-bytes of memory in an Eclipse with at least 256 K-bytes. However, the memory-management features allow manipulation of up to 512 megabytes of logical address space.

At Harris Corp.'s Computer Systems Division, Fort Lauderdale, Fla., "We've developed another flavor of our operating system, " according to Rick Maule, director of product marketing. Tentatively dubbed RTVOS, for real-time virtual operating system, the new software is set for introduction during the fourth quarter of 1985. RTVOS is a stripped-down version of VOS—Harris's standard superminicomputer virtual operating system—aimed at yielding higher I/O throughput and optimized process management for real-time applications.

The operating system will run on Harris H60, H600, H700, H800, H1000, and H1200 machines (Fig. 4). Maule claims that Harris's hardware-intensive virtual-memory implementation on these machines is unique among superminis. The feature, he says, eliminates context-switching overhead and address-translation time.

More and more customers outside the traditional real-time market are beginning to recognize that they have applications requiring real-time features, notes Maule. Harris's approach allows engineers to develop software under a generalized VOS-based environment, where editing and debugging tools are readily available. Programs are then transferred over to real-time RTVOS control.

RTVOS will see service primarily in data-acquisition and simulation applications, says Maule. The company's Harris Station model 10 and 20 work stations overcome the data-input bottlenecks in these applications. The units tie into the superminicomputers either through direct hookup or through Ethernet; they allow remote real-time data acquisition with centralized processing.

Data acquisition is itself a highly specialized area. But companies with real-time expertise increasingly are adopting it as their territory. Masscomp's Wallack says data acquisition is what makes his firm's systems unique.

Real-time isn't an open-loop proposition, according to Wallack. It's closed-loop—that is, the process is one of getting data into the computer, crunching on it, then sending it out and generating control commands for an instrument or sensor. Typically, data-acquisition systems that hinge on the rapid input and processing of thousands of data points span such diverse applications as laser firing control, communications-satellite testing, voice recognition, and simulation of human motion.

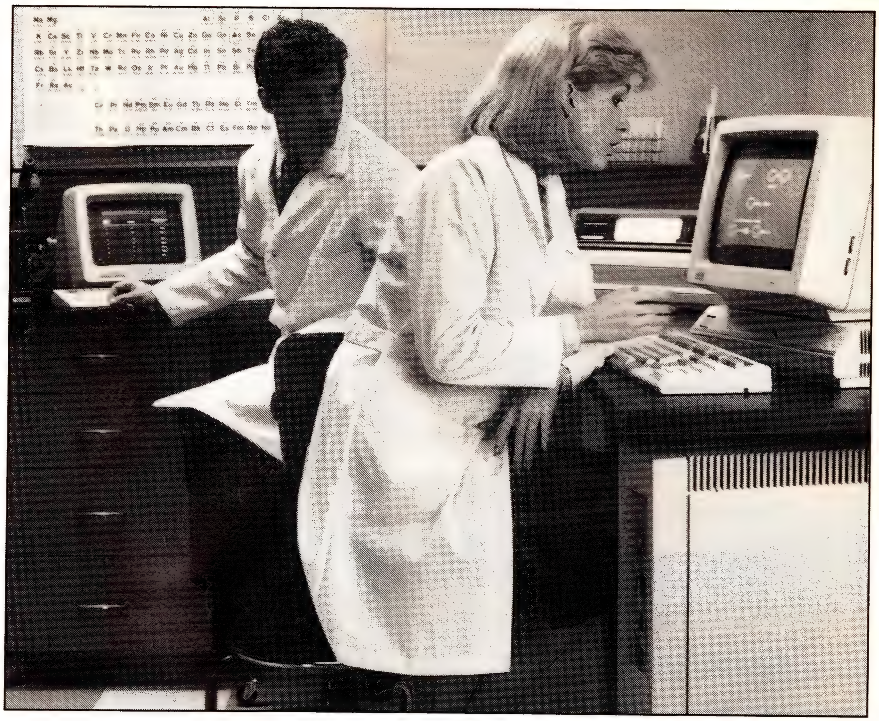
Masscomp's design emphasizes total system performance, according to Wallack. The focus on analog-to-digital converters had become obsolete. Now it turns out that bus structures, CPUs, and operating systems are equally critical.

Masscomp's two-year-old MC-500 uses multiple 16-bit 68000-family microprocessors in a 32-bit configuration. The data acquisition function is offloaded to a separate 8-million-instructions/s bipolar processor (Fig. 5).

The machine has a unique three-bus architecture. The microprocessor hooks up to memory through a proprietary bus. An STD-bus is structured to route continuously sampled data directly into memory or disk. An Intel Multibus supports system peripherals.

The MC-500's operating system derived from standard Unix System V. But Masscomp added features to bring it up to real-time standards. Leading the list is a fixed priority scheduler, which allows the highest-priority real-time task to take control of the processor and lock out other functions. Asynchronous system traps provide interprocess synchronization. Increased buffer space in physical memory speeds interprocess communication.

This past May, Masscomp announced a hardware upgrade package to the basic machine that increases floating-point performance to over 700,000 whetstones/s, the company claims [*ElectronicsWeek,* May 20, 1985, p. 14]. Future product plans include additional ADC and interface modules.



6. GOOD CHEMISTRY. Digital Equipment Corp.'s Microvax II systems are being used in labs for complex organic-chemistry modelling, which often requires real-time operation.

On the operating system front, "we're working to increase the programmability and performance of our front-end hardware," says Wallack. And several low-end product introductions are due this winter, he says.

SPEAKING IN TONGUES

The road to high performance is paved with programming languages, according to many experts. The C programming language, aided by products such as Hunter & Ready's Real-Time C package, seems to be moving out in front as the dominant high-level language for real-time programming.

For years, assembly language had been the real-time coding leader. But structured programming techniques and new software design methodologies have helped nudge the assembly languages aside. Today, C and the other higher-order languages are viewed as easier to teach to programmers and cheaper to debug and maintain.

Strong proponents of the C language include Whitesmiths' Plauger, who heads up an Institute of Electrical and Electronic Engineers C standards committee, and Edward Rathje, vice president of JMI Sofware Consultants Inc., Spring House, Pa. Version 2.0 of JMI's C Executive real-time operating system, released last March, incorporates a high-performance file-handling system and refines type checking to enforce design standards—a critical industry issue—for larger programs. The rapidly increasing demand for applications software is boosting C and the other higher-order languages.

The Forth programming language, however, has emerged as a high-level competitor to C. Charles H. Moore invented Forth in the early 1970s to control the National Radio Astronomy Observatory's telescope. In 1973, Moore formed Forth Inc. with observatory colleagues Elizabeth D. Rather [*ElectronicsWeek,* May, 13, 1985, p. 46] and Edward Conklin.

Today, the company's principal product is Polyforth 2, a multitasking, real-time operating system that brings the language to a variety of personal-sized and embedded systems. Says Rather, who is president of the firm, "We're in the business of making small computers outperform big computers using software."

Most recently, the company announced that dedicated hardware aimed at further optimizing Forth for real-time applications was on the way. In conjunction with Novix Inc., Cupertino, Calif., it introduced an NC4000 16-bit processor equipped with Forth's operating system, programming language, and development tools. Novix claims that a prototype version ran a standard benchmark algorithm, known as the Sieve of Eratosthenes, in 0.3 s. A 68000 takes 4.9 s to run a similar assembly-language program, and 14.0 s for a Pascal version, Novix says.

The recent 1985 Rochester Forth Conference brought together 175 attendees to hear some 66 technical papers focusing on the language's implementations and applications. Rather delivered a guest lecture describing her company's current project, billed as the "most demanding Forth application ever undertaken." Fifteen programmers, 400 computers, 36,000 sensors, and the Forth programming language are combining to fully automate the King Khaled International Airport near Riyadh, Saudi Arabia.

HIGH-FLYING FORTH

Forth is also doing real-time duty on the space shuttle. Last October, the software supported the McDonnell Douglas Astronautics Co.'s electrophoresis experiment. A harbinger of commercial ventures in space, this zero-gravity venture tested the separation of biological materials to aid in the search for new pharmaceuticals.

Closer to home, Bell Canada implemented Polyforth 2 on a 200-megabyte, 68000-based system. A network of 32 remote terminals ties into that processor, monitoring Bell's telephone switching system, recording, analyzing, and locating faults. "And I think there's a major opportunity for Polyforth in expert systems," says Rather. She notes that several customers are developing applications for industrial vision systems geared to product inspection. Forth wants to develop more applications-oriented products. One possibility on the drawing board is a low-end vision system linked to a personal computer. ☐

PRODUCTS NEWSLETTER

20-MEGABYTE BERNOULLI BOX DRIVES WILL SOON BE AVAILABLE TO OEMs

Early next year, original-equipment manufacturers will be able to integrate 20-megabyte versions of Iomega Corp.'s Bernoulli Box, which uses air flow to couple a fast-spinning flexible disk to the head. Scott D. McVay, vice president of marketing and sales for the Roy, Utah, company, says the drive will fit in any 5¼-in.-high opening and can support any interface. Meanwhile, Iomega, whose sales jumped from $7 million in 1983 to $51 million last year, is upgrading its line of stand-alone subsystems. Four new models, all using 8-in. cartridges, are more compact, weigh less, and store more than their predecessors. The 10-megabyte single drive and 20-megabyte dual drive have 35-ms average access times; the 20-megabyte single drive and 40-megabyte dual drive have 38-ms average access times. ☐

68020-BASED MICROCOMPUTER RUNS IBM 370 MAINFRAME SOFTWARE

Icon Systems and Software Inc., Orem, Utah, will release the first of a series of high-end supermicrocomputers based on the Motorola 68020 processor for beta testing next month. Sanyo Electric Co. of Japan, which owns 40% of Icon [*Electronics*, Aug. 12, 1985, p. 35], will build the computers in Japan, and Icon will market them to original-equipment manufacturers and some end users. The systems, which will be shipped starting in October, are compatible with the operating system of the IBM Corp. 370 mainframe and run concurrently under MS-DOS and two flavors of Unix: System V and 4.2bsd. The MPS 020-2 entry-level system, priced at $15,000, is rated at 3 million instructions/s and will support 32 users. ☐

TWO CHIPS MAKE MULTIBUS II DESIGNS A SNAP

Two new interface integrated circuits that connect the Intel Corp. Multibus II bus and single-board computers should cut both the cost and time to market for board and system makers. The CMOS BAC 84110 bus arbiter/controller, from Toshiba America Inc., Tustin, Calif., in an 84-pin package, oversees the use of the parallel bus in a Multibus II multiprocessor system. The message interrupt controller, MIC 84120, also in CMOS and housed in a 68-pin package, generates and receives interrupt messages for host processors or peripheral controllers. Available now, the two components come either as a single kit, for $127.50, or separately. ☐

MAC SOFTWARE COMBINES IMAGES AND DATA BASES

Now that computers can handle digitized images with no problems, data bases that combine text and pictures are beginning to emerge. Business Filevision software, to be introduced this week at Macworld Expo in Boston, links text and illustrations on the Apple Computer Inc. Macintosh into files that can hold 4 megabytes—about 3,200 records, depending on the ratio of graphics to text. Pricing has not been set. In a related introduction, Chorus Data Systems Inc., Merrimack, N. H., is bringing out Photobase, which creates photo-and-data archives on the IBM Corp. Personal Computer. The software sells for $690 and the required display adapter for $695. ☐

CGX'S IBM 5080-COMPATIBLE TERMINAL DOES LOCAL 3-D PROCESSING

An IBM 5080-compatible intelligent graphics terminal from CGX Corp., Acton, Mass., speeds display performance by 50% and has three-dimensional processing capability. The CGX 2033, at $33,800, is a color-raster work station with 1,024-by-1,024-pixel resolution, 256-color capability, and a 60-Hz noninterlaced refresh rate. The terminal also has 640-K bytes of memory. ☐

AMD WILL START TAKING ORDERS FOR ITS 32-BIT BIPOLAR FAMILY

MICROPROCESSORS ARE AIMED AT KEEPING BIPOLAR LEAD

While the world's semiconductor giants fought over the MOS microprocessor market, Advanced Micro Devices has walked off with the bipolar world. The Am2901 family of bipolar 4-bit bit-slice chips, which AMD introduced 10 years ago, remains so popular that the circuits are still designed into signal-processing, graphics, and controller applications—wherever bipolar's speed is advantageous. To keep the momentum going, AMD has moved the 2901's functions onto separate chips in a more powerful 32-bit family. The 29300 is the first line of 32-bit bipolar microprocessors.

The 29300 family was announced last fall [*ElectronicsWeek,* Nov. 12, 1984, p. 19], with samples scheduled for shipping earlier this year. After some delays, the company has begun fabricating all but the parallel fixed-point multiplier. AMD will begin taking orders for the first member of its new family, the 29325 floating-point accelerator, next month, with delivery scheduled shortly thereafter. In lots of 100, it will sell for $695 each.

The other circuits, to follow later this year and early next, are the 29334 register file (AMD recently obtained first silicon on the 29334), the 29331 16-bit sequencer, the 29332 arithmetic logic unit, and the 29323 parallel multiplier.

The 32-bit 29332 ALU opens up even more applications. At higher levels of integration, the bit-slice technique becomes inefficient, according to AMD. For example, the carry function demands continual off-chip delays as the carry process cascades through multiple 4-bit 2901s. In addition, certain functions, such as barrel-shifting and setting priorities, are not appropriate to bit-slice technology.

Like the 2901, the 29300 family is designed for high speed and versatility. It is built with AMD's 1.5-μm IMOX-S process (for ion-implantation, oxide isolation, with scaling). This process uses wafer-stepper technology and anisotropic (perpendicular) etching to obtain small device size and high speed. The chip's internal ECL gates exhibit typical gate delays of 0.8 ns at 1 mW/gate. On the floating-point chip, I/O devices are structured as TTL gates for compatibility with other system elements.

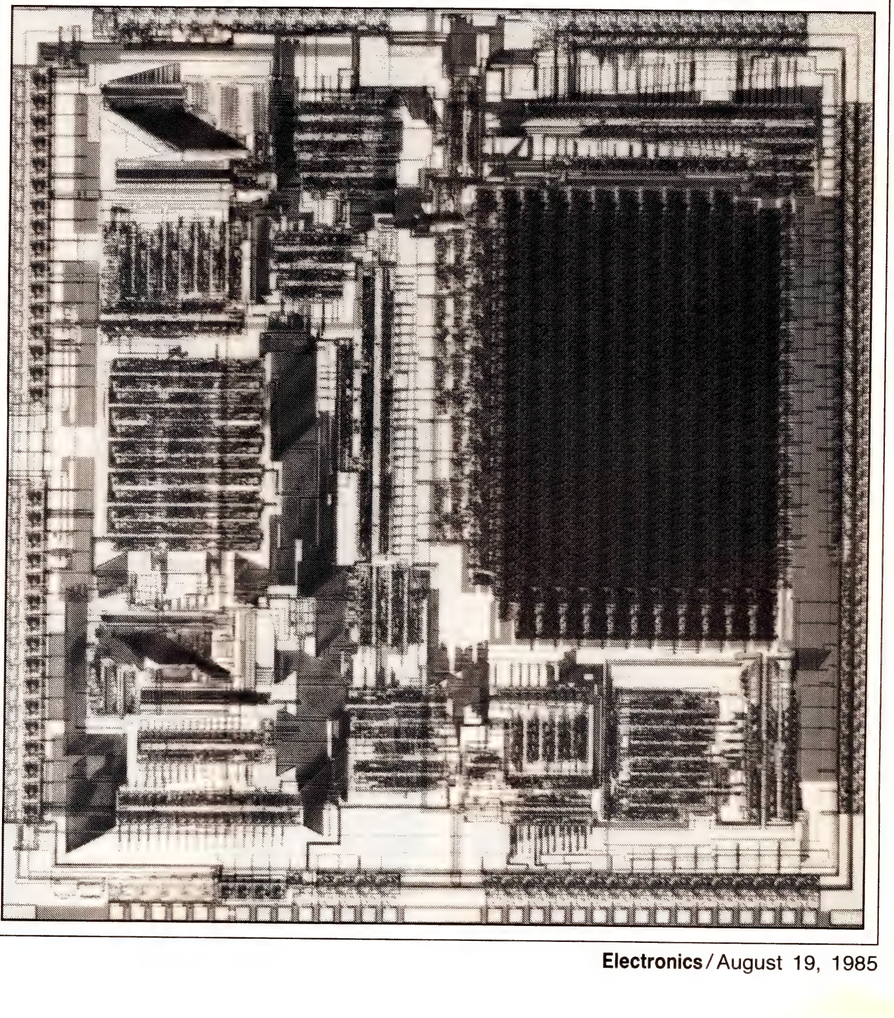
The 29325 may well be the hottest floating-point chip around—literally and figuratively. It will perform 32-bit floating-point addition, subtraction, and multiplication in a single cycle at a blazing 8-MHz clock rate; 10-MHz operation is a near-term goal. The chip, which at 129,600 mils^2 is AMD's largest bipolar device, pays a price for its speed: it dissipates 7.5 W and requires a special finned package to keep it cool.

HEAT SINK. This package, a pin-grid array with 144 pins, will be home for the family. The die is mounted upside down and leads are attached from the bottom. The heat generated flows upward through three fins in a heat sink on top.

All chips in the family are designed with a three-bus flow-through architecture so they can accept two 32-bit inputs and produce a 32-bit output in a single cycle. The 29325 executes add, subtract, and multiply instructions in one cycle. It also executes a constant-subtract instruction to support the Newton-Raphson division algorithm. The chip will switch between IEEE and Digital Equipment Corp. VAX floating-point formats, or from fixed point to floating point in one cycle.

The simplest applications for the 29325 are as an accelerator for single-board computers using Multibus, VME-bus, or other microcomputer bus structures. AMD also expects it to be used in radar and military applications, communications, and robotics, says Stephen K. Campbell, product marketing manager.

On the high end, the chip will be used on graphics boards and in superminicomputers where the double-precision 64-bit operations are not required, he says. An IBM Corp. Personal Computer AT with a 32-bit board containing the 29325 will perform matrix arithmetic, Campbell points out. "This gives you the



KEEPING COOL. AMD's largest bipolar chip, the 29332 dissipates a whopping 7.5 W and requires special packaging to keep it cool.

capabilities of the 32-bit array processor of a few years ago in a personal computer," Campbell says. "It's a scientific computer on a desktop."

The 29332 features a microprogrammable instruction set so the user can change instructions by changing a PROM. The 16-bit sequencer allows up to 64-K words of microcode memory to be addressed.

Manufacturing will be transferred from AMD's 5-in. bipolar wafer line in San Antonio, Texas, to the neighboring 6-in. line in San Antonio by late this year or early next. *–Clifford Barney*

Advanced Micro Devices Inc., 901 Thompson Place, Sunnyvale, Calif. 94088.
Phone (408) 748-5144 [Circle reader service number 338]

IBM PC AT CARD GETS 12-BIT IMAGING

Designed for the IBM Corp. Personal Computer AT, the FG-100-AT is a single-board image-processing system that contains 12 bit-planes of frame memory, with a spatial resolution of 512 by 512 pixels. There are several ways to manipulate the frame memory: in one mode, frame memory uses 8 bits for the image, leaving 4 bits available for windowing and graphics overlays; in another, two 6-bit images can be stored for processing and display.

Typical applications for the FG-100-AT include graphics, inspection, medical imaging, and machine vision.

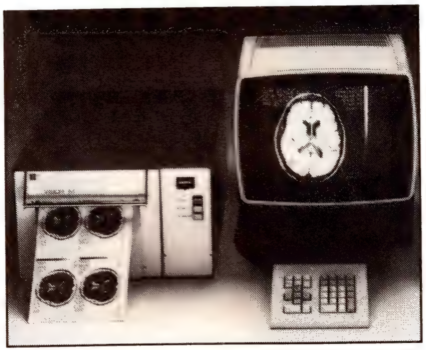
The board is available in two versions: monochrome, for $3,995, and pseudocolor—up to 4,096 colors—for $4,495. The manufacturer grants volume discounts for both models. Shipments are scheduled to begin in November.

Imaging Technology Inc., 600 W. Cummings Park, Woburn, Mass. 01801.
Phone (617) 938-8444 [Circle 350]

IMAGE SYSTEM ACCEPTS VCR SIGNALS

The Grayline imaging system acquires, digitizes (into gray scales), displays, stores, and puts out video and laser hard-copy images from any standard video source, including a videotape recorder. It can also receive and put out digital display data either on-site with the host or at remote locations through networked communications. The manufacturer also offers a full image-processing package with a sliding gray scale, capable of converting video input to prints or transparencies.

Said to be useful for medical-imaging applications, the imaging system can display up to four separate images (in 256 shades of gray) on its 512-by-480-pixel monochrome screen. A digital laser printer produces a high-resolution image (in 128 shades of gray) that is independent of screen-display resolution.



The Grayline is compatible with IBM Corp. Personal Computers and is priced at $35,000, with delivery being made in 14 days. The image-processing package carries a pricetag of $1,500.

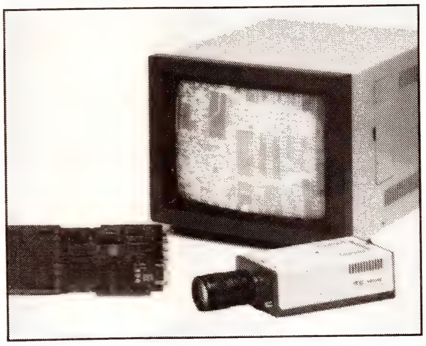
Image Atlanta Inc., 1175 Old Ellis Rd., P. O. Box 249, Roswell, Ga. 30077.
Phone (404) 442-3445 [Circle 351]

IMAGE CARD FITS IN ONE IBM PC SLOT

A real-time image-acquisition and -display board for the IBM Corp. Personal Computer, PC/XT, and PC AT, the PIP-512 occupies one expansion slot and requires only 15 W of power. Display resolution is 512 by 512 pixels with 256 colors per pixel. A write-protect mask selectively disables writing to any of the eight individual bit planes; then protected planes can be used for overlays containing characters, cursors, or graphics.

Each of the three digital-to-analog converters has an associated 256-entry output-lookup table for generating pseudocolors and highlighting algorithms. For panning and scrolling, the PIP-512 provides programmable roam capability to a resolution of 8 pixels horizontally and 16 lines vertically.

A software package, Pip-ez, gives the applications programmer standard system calls, a well-defined library interface, and a high-level language. The PIP-1024, a variant of the PIP-512, quadruples the size of the frame buffer by using 256-K RAM chips.



The PIP-512 board sells for $1,995 and the PIP-1024 for $2,495; quantity discounts are offered for both. Delivery is from stock.

Matrox Electronic Systems Ltd., 1055 St. Regis Blvd., Dorval, Quebec, Canada H9P 2T4. Phone (514) 685-2630 [Circle 352]

GOULD BUNDLES IBM PC AND IMAGE PROCESSOR

Bundling its FD5000 image-processor, an IBM Corp. Personal Computer, an interface, and Mini-Lips software, Gould is introducing an image-processing work-station system for remote sensing, medical imaging, graphics, and nondestructive testing applications. Mini-Lips, a capsule version of the manufacturer's Library of Image Processing Software, can be used as the base for program development on the FD5000 or as the image-processing control system.

For users who already own an IBM PC, Gould provides an interface that links the PC to the image processor and Mini-Lips. Prices for the system, which will not be available until the fourth quarter, have not been set.

Gould Inc., Imaging and Graphics Division, 46360 Fremont Blvd., Fremont, Calif. 94538. Phone (415) 498-3300 [Circle 353]

ASSEMBLER CREATES 68010 SOFTWARE

Designed for Digital Equipment Corp.'s VAX and Microvax computers, the BSO/Assembler II provides software support for the increasingly popular Motorola Inc. 68010 microprocessor. The relocatable assembler optimizes assembly speeds and eliminates symbol-space restrictions based on system-memory limitations.

All executable instructions and addressing modes are identical with the Motorola-defined assembly syntax, which simplifies the moving of existing programs to the BSO/VAX environment. The 68010 assembler is also upwardly compatible with most Motorola formatted macros.

The BSO/Assembler II, which sells for $4,900, can be delivered in 10 days.

Boston Systems Office, 128 Technology Ctr., Waltham, Mass. 02254.
Phone (617) 894-7800 [Circle 355]

'TALKING' SOFTWARE IS ENHANCED

The latest version of PC Talking Program, which lets microcomputers running MS-DOS talk with no modification to hardware, has more than two dozen enhancements. Many were suggested by

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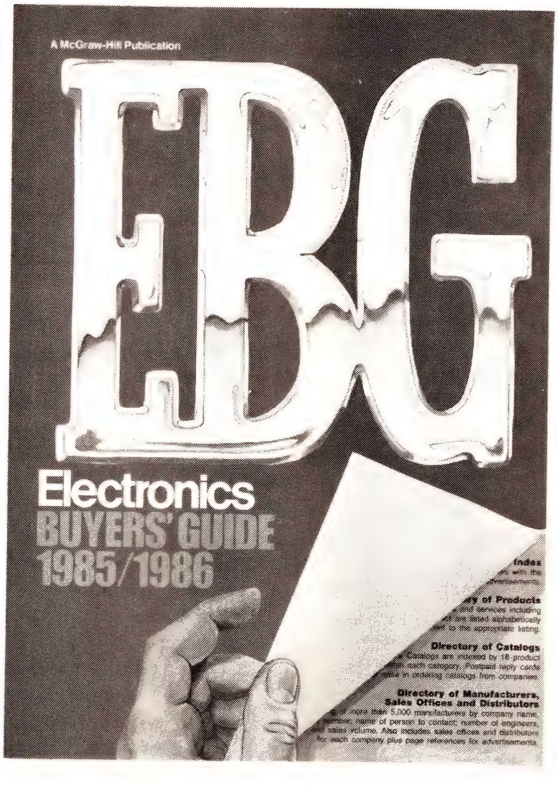
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Electronics
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Power Supplies Trends

Technology advances in power supplies are shrinking their size and weight, improving efficiency, and reducing heat. Integrated power semiconductor chips are also having an impact on the power supplies industry, while new design approaches are achieving higher speed switching. Techniques used to meet FCC and Class A and B radiation specs will also be covered.

The Market
Technological improvements and growth in the use of electronic equipment will help this small but vital industry grow from about $150 million in 1984 to more than $250 million by 1990, according to industry estimates.

Target Readers
Design engineers, system engineers, project managers.

Issue Date: September 16, 1985

Closing for Advertising: August 26, 1985

Electronics
Influence Beyond Design

Electronics
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Technology Update: Computers

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Learn why parallel multi-computer and multi-processing architectures, reduced-instruction-set computers, and artificial intelligence are having a special impact on computer technology. Optical storage in the area of peripherals will also be covered.

The Market
$70.4 billion in the U.S. in 1985; $80.7 billion in 1986.

Target Readers
All computer and system designers; technical, marketing, and corporate managers in electronics and computer companies.

Issue Date:
October 7, 1985

Closing for Advertising:
September 16, 1985

Electronics
Influence Beyond Design

users of the original version. The enhanced version works with Digital Equipment Corp.'s Talk and the Data General One portable computer plus more than 30 other computers and 95% of off-the-shelf software.

With the enhanced PC Talking Program, the default mode is video speech. With interactive toggle controls, the user can choose total spelling or spelling with upper- and lowercase identification; whole-screen, line, partial-line or single-word review; and random-line review. The software tells the line and column position of the cursor and notifies the user when the screen's edge has been reached. PC Talking Program, which is written in machine language and takes up less than 6-K bytes of memory. Once the system is booted up, it becomes part of the operating system.

With the enhanced PC Talking Program, blind users can take advantage of its complete talking telecommunications capabilities.

Computer Conversations, 2350 N. Fourth St., Columbus, Ohio 43202.
Phone (614) 263-4324 [Circle 354]

SOFTWARE POLISHES BUSINESS CHARTS

For organization charts, Gantt charts (schedules), flow charts, decision trees, and other types of report illustration, Diagram-Master software creates high-resolution graphics that will reproduce on plotters, printers, and the Polaroid Palette 35-mm slide maker.

With Diagram-Master's Drawing Board and a library disk of 101 shapes and symbols frequently used in business communications, the user can enter company logos or other custom drawings. Shape, text, and plotting options give the user a flexible range of sizes and colors to choose from.

What's more, diagrams made with application programs can be brought to the Drawing Board to add enhancements and final touches. Compatible with IBM Corp. desktop computers, Diagram-Master supports a long list of printers and plotters including models from Epson, Hewlett-Packard, IBM, Apple, Gould, and Okidata.

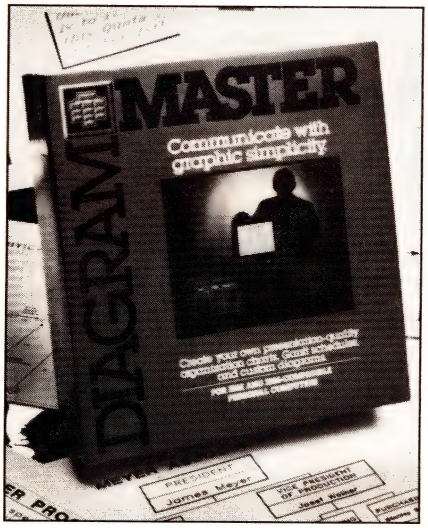


DIAGRAM MASTER
Communicate with graphic simplicity
PRESIDENT
James Meyer
VICE PRESIDENT OF PRODUCTION
Josef Walker

In release 5.0, Diagram-Master comes on four disks and sells for $345.

Decision Resources, 25 Sylvan Rd. S., Westport, Conn. 06880.
Phone (203) 222-1974 [Circle 356]

DISPLAY SOFTWARE RACKS UP DATA

Zoomracks software takes windows a step further by displaying any index-card-type data base in a format similar to a rack of timecards. Using Smartzooms, the user can view up to 10 racks at once, thanks to a proprietary text-compression technique, without overlap or hiding of information that occurs with windows. A keystroke then moves the user from the compressed information on several racks to expanded, detailed information from a single rack.

In an unusual marketing move, the developer is offering Zoomracks in a Sneak Preview edition, which in effect makes the user the beta-site tester. Buyers of the Sneak Preview version will be credited for changes and enhancements they suggest and will receive free upgrades to the "first-run" version of Zoomracks.

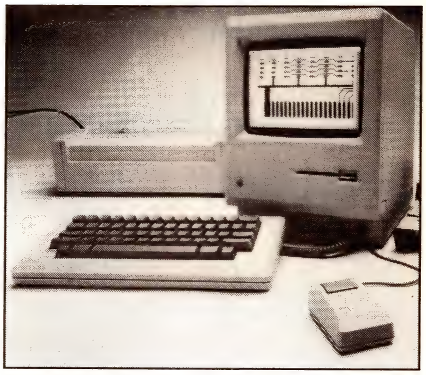
The copy-protected version of Sneak Preview will be available this month for $59.95. Unprotected, it will sell for $79.95. The first-run version will be released in November.

Quick View Systems, 146 Main St., Suite 404, Los Altos, Calif. 94022.
Phone (800) 443-0100 [Circle 357]

SOFTWARE MAKES MAC A PC-BOARD DESIGNER

Quik Circuit, a one-stop package for pc-board designers, contains an Apple Computer Inc. Macintosh, peripherals, and computer-aided design software. The engineer enters designs with the mouse; these are produced on either the Apple Imagewriter printer or a pen plotter from Quik Circuit's manufacturer.

To speed fabrication of boards designed on Quik Circuit, the manufacturer has set up a computer-aided-manufacturing network of pc-board fabricators equipped to produce boards from designs generated on Quik Circuit systems. The fabricator works directly from the designer's file disk, bypassing data conversion, thus saving time and money, the company claims.



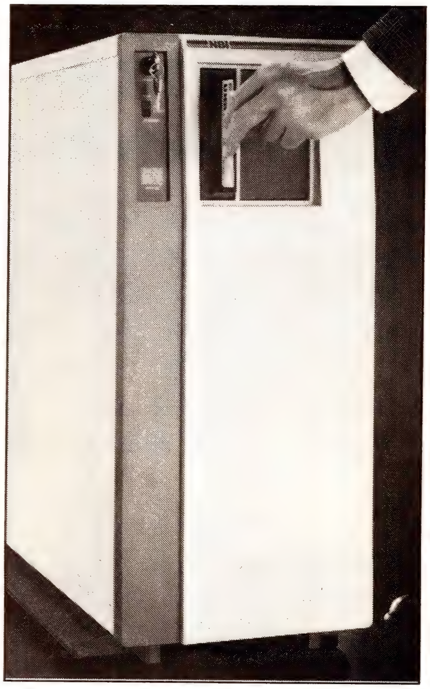
A complete system sells for $4,300. For designers who already own a Macintosh, the software is available separately for $695. Pen plotters sell for $1,315.

Bishop Graphics, 5388 Sterling Center Dr., P.O. Box 5007, Westlake Village, Calif. 91359. Phone (818) 991-2600 [Circle 358]

SYSTEM LINKS OFFICE GEAR

NBI has expanded its office-automation line on a number of fronts. Designed as a shared-resource system for clustering word-processing and personal computer work stations in the office, the Oasys 64/es provides 1 megabyte of memory and is available with 38, 76, or 168 megabytes of disk storage in a tower-style cabinet. System prices start at $14,900.

Multinet Remote-Link lets a user in a location outside the office access the complete range of NBI's office equipment, including electronic mail, word processing, data bases, personal computer files, and software libraries. Remote-Link sells for $3,995 and will be available in the fourth quarter. Multinet Of-



fice-Link is an adapter that attaches up to eight work stations to the Multinet local-area network over standard telephone cabling. Priced at $395, it will be available in September.

NBI Inc., P. O. Box 9001, Boulder, Colo. 80301. Phone (303) 938-2668 [Circle 363]

STRIDE ADDS LOW-END ENTRY-LEVEL MICRO

The Stride 440 microcomputer now comes in a single-floppy-disk model with 256-K bytes of RAM. The manufacturer is introducing this version as an entry-level system that can operate as a stand-alone unit or as part of a network. The standard package is based on the 10-MHz 68000 microprocessor, a 640-K-byte floppy-disk drive, Omninet and Liaison networks, and Teletalker communications software.

A number of options let the user expand the 440 into a larger and more versatile system. There is a choice of 11 operating systems, including Unix System V, as well as over 30 language compilers, a second floppy disk, graphics capability, a floating-point math coprocessor, and an upgrade to a 12-MHz microprocessor.

The suggested retail price of the model 440 microcomputer is $2,995.

Stride Micro, 4905 Energy Way, Reno, Nev. 89502.
Phone (702) 322-6868 [Circle 362]

FORTUNE ADDS UNITS WITH 12-MHz 68000

Fortune Systems has added a new top-of-the-line series to its 32:16 family of multiuser computer systems. The SX series features higher performance and greater storage capacity than the company's XP and PS products. Based on the 12-MHz 68000 microprocessor, the SX70 comes with 1 megabyte of RAM with parity. Mass storage available on the SX70 is a 70-megabyte Winchester disk drive that has an average access time of 28 ms and an 800-K-byte floppy-disk drive. The price of the SX70 is $14,995.

The SX70T enlarges backup capacity with a 60-megabyte cartridge streaming tape drive housed in the main CPU cabinet along with the hard disk and the floppy disk. Its price is $17,590. The SX70 models serve up to 24 users.

Any of the five available I/O slots in the SX70 or SX70T system can hold Fortune:Link, an Arcnet-based controller board plus software that transmits data between two computer memories at 100 to 300 kb/s. Up to 255 32:16 terminals can be connected to Fortune:Link over 4 miles of cable. The price of the system starts at $1,795 and goes according to configuration.

With Fortune:Windows, an operator can open and concurrently run up to eight windows on a single SX70 terminal. A default configuration can be created for each operator's most frequently used applications; a menu lists active (open) windows and their status. The price of the software is $695.

The SX70 is available this month, the SX70T and Fortune:Link will be out in September. Fortune:Windows is available now. Upgrades are also offered for current users of this company's office-automation equipment.

Fortune Systems Corp., 101 Twin Dolphin Dr., Redwood City, Calif. 94065.
Phone (415) 595-8444 [Circle 391]

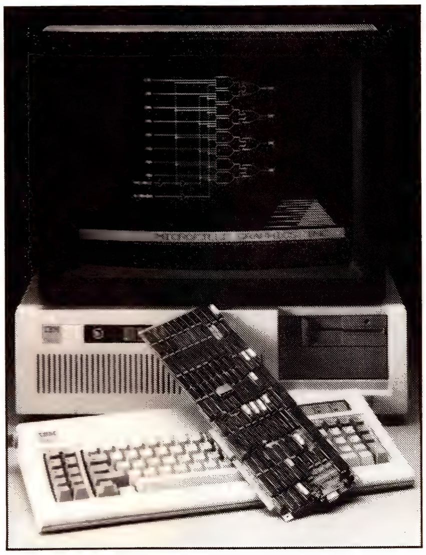
TOOLKIT CUSTOMIZES GRAPHICS FOR IBM PC

Bit-slice graphics, previously found only on high-end graphics work stations, now are possible on the IBM Corp. Personal Computer, thanks to the the T4 graphics controller. With a resolution of 1,024 by 800 pixels, the controller is targeted at original-equipment manufacturers producing personal-computer-based work stations for computer-aided engineering, -design, and -manufacturing.

With the optional T4 Development Tool Kit, which includes a PC-DOS editor, a T4 simulator, source code, and other software. OEMs can create proprietary graphics applications.

The user can perform all programming at the microcode level. And using the company's proprietary version of Virtual Device Interface, MVDI, graphics applications can be transported from other computers to the PC AT.

Based on fast, low-power CMOS gate arrays, the T4 gives writes over 1 million pixels/s. Available now, the T4 con-



2 GPIB

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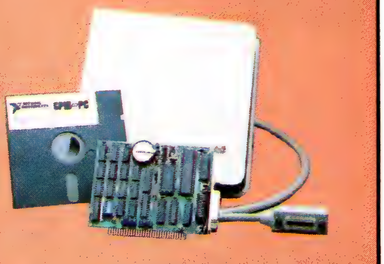

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Circle 53 on reader service card

troller sells for $3,200; the T4 Development Tool Kit sells for $100,000.

Microfield Graphics Inc., 8285 S.W. Nimbus Ave., Suite 161, Beaverton, Ore. 97005. Phone (503) 626-9393 [Circle 367]

ENGINE ENABLES PC AT TO DRAW 3-D IMAGES

The WTE 7100 PC solids modeling engine, which fits into the IBM Corp. Personal Computer AT, provides interactive three-dimensional wireframe graphics, shaded images, and floating-point-array processing—all with the same hardware.

Adaptable to the user's requirements, the engine's microcode can be downloaded into an 8-K-by-96-bit writeable control store on the board set to change applications software. For customization of software, the manufacturer offers a meta-assembler.

Fully transformed 3-d wireframe objects are drawn at the rate of 4,000 vectors/s; objects rendered in Gouraud shading and translucent surfaces are produced at the rate of 60,000 pixels/s—4 to 6 s for an object that would otherwise take minutes to draw.

The wireframe-graphics version of the WTE 7100 is available this month, and the shaded-image microcode is coming in November. In OEM quantities, the engine sells for less than $4,000 per board set.

Weitek Corp., 1060 E. Arques St., Sunnyvale, Calif. 94086.
Phone (408) 738-8400 [Circle 368]

PROCESSOR DRAWS 100,000 VECTORS/S

A vector-to-raster graphics processor, the Turbograph 700 is a dedicated standalone processor that draws an average of 100,000 vectors/s. Its maximum speed is 400,000 vectors/s. The Turbograph 700 generates pages of text and graphics at a rate of 3 pages/s.

Shaded areas can be filled with user-selected patterns, and other features include variable line styles and opaque or transparent color overlays, plus self-testing diagnostics.

Raster-image memory and input memory can be expanded to 2 megabytes each, which lessens the burden on the CPU and minimizes the amount of data formatting. With the large memory, a complete image can be output quickly to the printer or plotter.

Value-added resellers can configure the Turbograph 700 for host computers using standard 8- and 16-bit input interfaces. An option is the ability to multiplex several output devices, including inkjet and laser hard-copy peripherals.

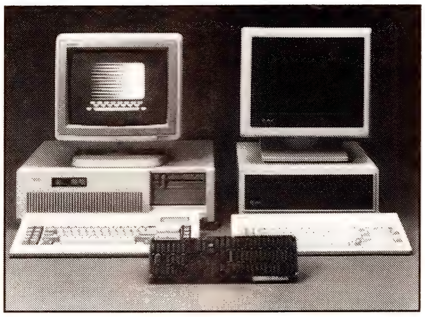
A single Turbograph 700 lists for $6,995. Quantity discounts are available, and delivery is in 90 to 120 days.

AMF Logic Sciences Inc., 10808 Fallstone Rd., Houston, Texas 77099.
Phone (713) 879-0536 [Circle 369]

GRAPHICS CARD FILLS SHAPES QUICKLY

Designers of the Omega PC graphics controller drew on their earlier products designed for larger hosts to achieve a drawing speed of 3 million pixels/s. Polygons fill at up to 30 million pixels/s.

The Omega PC delivers high-resolution, 1,024-by-1,024-pixel color graphics with a viewable resolution of 1,024 by 768 pixels on the IBM Corp. Personal Computer AT and its compatibles. Four bit planes display 16 colors from a palette of 4,096, and the noninterlaced refresh rate is 60 Hz.



The Omega PC sells for $2,500. Delivery is planned for the fourth quarter.

Metheus Corp., 5510 N.E. Elam Young Pkwy., Hillsboro, Ore. 97124.
Phone (503) 640-8000 [Circle 392]

APOLLO WORK STATION BUILT AROUND 68020

Apollo Computer has put the Motorola Inc. 68020 microprocessor to work in three new products for significant increases in the price-performance level of its Domain work-station line: the DN330 work station, the DN560 color-graphics work station, and the DSP90 network-server processor. Apollo also launched its open-architecture program, creating integrated networks of computers from multiple vendors.

The DN560 features a dedicated, bit-slice graphics processor, integrated floating-point hardware, a 19-in. color monitor with a 1,024-by-800-pixel resolution, and keyboard. The DN330 uses a 17-in. monochrome monitor with the same resolution, keyboard, floating-point hardware, and a local-area-network interface. Both stations can have up to 3 megabytes of main memory.

The DSP90, an intelligent peripheral and communications server, improves work-station performance by offloading the overhead of managing peripherals and communciations tasks. It comes with 2 megabytes of memory and a dedicated floating-point coprocessor.

The DN560 sells for $35,500, the DN330 $15,900, and the DSP90 $18,000. Delivery takes from 90 to 120 days.

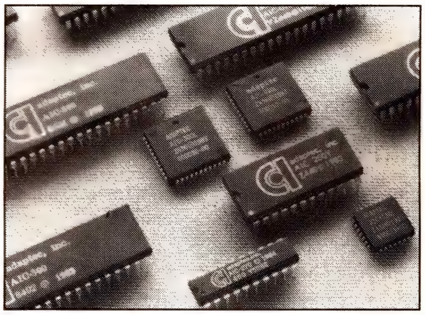
Apollo's open-architecture program includes a series of software and hardware products that permit the Domain series computers—through industry-standard interconnections—to work with Digital Equipment Corp.'s VAX computers and IBM Corp.'s mainframes (using Systems Network Architecture protocols) and IBM Personal Computers.

Apollo Computer Inc., 330 Billerica Rd., Chelmsford, Mass. 01824.
Phone (617) 256-6600 [Circle 380]

CONTROLLER IC FOR DISK-DRIVE MAKERS

Controller maker Adaptec is taking the custom chip it has been using in its own products to the IC market. It hopes to sell to the disk-drive manufacturers that are beginning to integrate their own controllers into their drives.

System designers using the AIC-010 I/O-storage-controller chip can work with all drive interfaces, including the ST506, ST412, Storage Module Drive,



INTEGRATED CIRCUITS

Enhanced Small Disk Interface, and the QIC-36. It allows access to all encoding and decoding schemes, such as 2,7 run-length limited, modified frequency-modulation, and group-coded recording.

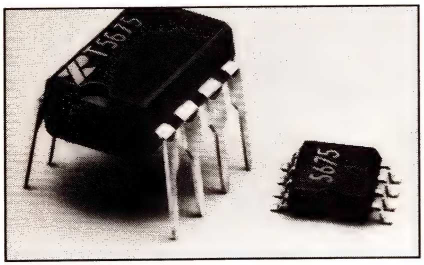
The chip comes in 5-, 10-, and 15-MHz versions. In lots of 2,500 pieces, the 10-MHz version sells for $50 each. A 24-MHz model selling for $120 each in like quantities will be available early next year.

Adaptec Inc., 580 Cottonwood Dr., Milpitas, Calif. 95035.
Phone (408) 946-8600 [Circle 393]

LOW-POWER IC HANDLES PCM TASKS

A dual-line driver IC designed for all pulse-coded-modulation line and computer-peripheral applications uses 20% less power than comparable driver ICs. A single 5-V supply powers the XR-T5675, which consumes just 15 mA to drive digital PCM lines at up to 10 Mb/s.

The part is best suited for driving the PCM line through an output transformer on the T1, T1C, T2, and European 2.048- and 8.448-Mb/s PCM systems. In addition, it works with line cards, multiplexers, digital service units, and channel service units. The chip drives local-area networks, buses, or lamps.



Priced at $1.37 each in lots of 10,000, the XR-T5675 is available now.

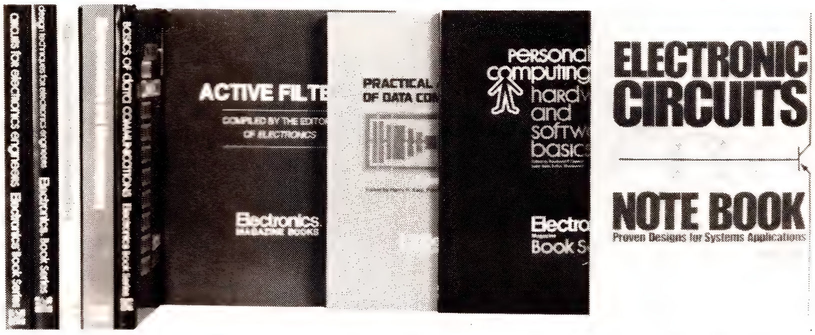
Exar Corp., 750 Palomar Ave., Sunnyvale, Calif. 94088.
Phone (408) 732-7970 [Circle 395]

80286 SUPPORT CHIPS RUN AT 8-MHz CLIP

Three support peripheral ICs and a second-source version of Intel Corp.'s 80286 microprocessor come in 6- and 8-MHz versions.

Besides the 16-bit 80286 with on-chip memory management and protection, the manufacturer has the 82284P clock generator, the 82288P bus controller, and the 82289P bus arbiter. Adding the 82258C advanced direct-memory-access controller, a high-speed data manipulator, and a data-transfer IC enhances the microprocessor's performance.

Samples and production quantities of the chip set come in 68-pin ceramic leadless chip carriers. Samples of the micro-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processor in pin-grid-array packages are also available, with larger quantities ready by the fourth quarter. A 10-MHz chip set will also be ready during the fourth quarter.

In lots of 100, the 8-MHz 82284P sells for $16, the 82288P for $30, the 82289P for $47, 82258C for $100, and the 80286C for $130.

Siemens Components Inc., Integrated Circuits Marketing, 186 Wood Ave. S., Iselin, N. J. 08830.
Phone (201) 321-3400 [Circle 394]

LINEAR ARRAY CLAIMS 800-MHz BANDWIDTH

The model 7600 linear array, a semicustom logic circuit, combines a high-frequency linear process with Low-Power Schottky TTL gate-equivalent capabilities. The gain-bandwidth product of the small npn transistors is typically 800 MHz, for design of video amplifiers, high-speed comparators, and other circuits requiring wide bandwidth or the ability to operate at high speeds.

Active components include 138 small npn, 4 large npn, and 26 pnp transistors, plus 10 dual diodes. The combined value of the 384 diffused-resistor complement is 525 KΩ.

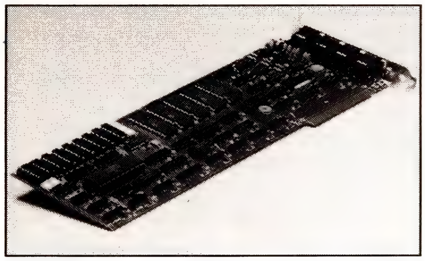
A typical layout for the model 7600 linear array is $4,800 depending on component use. The integration charge is $6,000, which includes 20 tested prototypes assembled in DIPs.

Cherry Semiconductor Corp., 2000 S. County Trail, East Greenwich, R.I. 02818.
Phone (401) 885-3600 [Circle 361]

CARD DELIVERS X.25 NETWORK LINK

With the Xpert PC card, users of IBM Corp. Personal Computers can connect to as many as four multiple hosts through an X.25-protocol packet-switched network. The Xpert emulates IBM 3270, DEC VT100, and a variety of ASCII terminals while attached directly to an X.25 network.

The card requires no packet assember-disassembler or protocol converters because the X.25 and terminal-emulation functions run on its own processor—freeing the PC's processor for other applications and provides error protection for all transactions.



Supporting data transmission up to 9.6 kb/s, Xpert links the IBM PC to Telenet, Tymnet, Accunet, and other public and proprietary networks. Units sell for $1,795 and ship in 45 days.

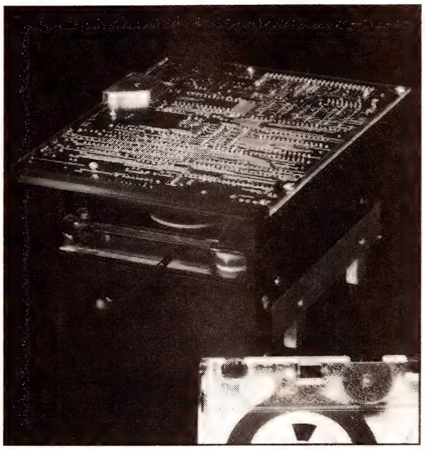
Atlantic Research Corp., 5390 Cherokee Ave., Alexandria, Va. 22312.
Phone (703) 642-4000 [Circle 370]

CARTRIDGE DRIVE HAS FAST FILE ACCESS

The HCD-134 data-cartridge drive system provides 134 megabytes of fully corrected user data in a formatted ¼-in. cartridge. Average file-access time is 20.1 s, and data transfer is accomplished at 70-K bytes/s.

The HCD-134 offers streaming and random-file or block-access operating modes as well as continuous or start-stop tape motion. The drive is housed in a 5¼-in. form factor.

Original-equipment manufacturers can integrate the HCD-134 into other systems using its industry-standard Small Computer Systems Interface (SCSI). 3M claims that any of its ¼-in. data cartridges recorded on any 3M system consisting of an HCD drive and controller will play back on any HCD-134.



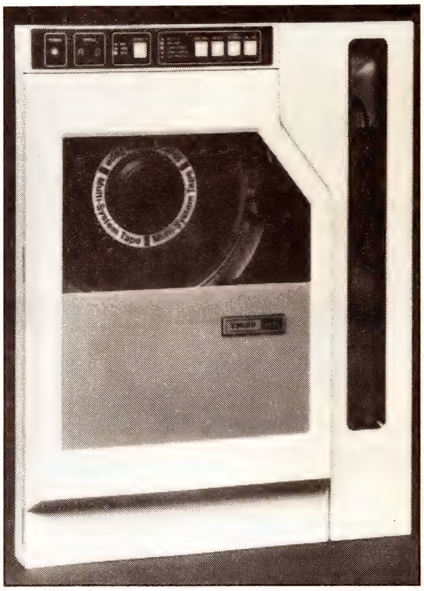
Priced at under $1,000 in volume, the HCD-134 drive will be available in the fourth quarter of 1985.

3M Co., P. O. Box 33600, St. Paul, Minn. 55133. Phone (612) 736-2355 [Circle 371]

TAPE SUBSYSTEM IS SELF-CHECKING

Self-diagnosis followed by self-adjustment is the key to the reliability of the model 9270 Shamrock group-coded recording tape subsystem. Four microprocessors monitor performance, then automatically compensate for board and motor changes, wear, and environmental conditions.

For further reliability, automatic loading and threading keeps operator handling of the tape to a minimum. One formatter can operate a daisy chain of up to three less-expensive slave units, saving on the cost of add-ons.



Since the model 9270 Shamrock interfaces with 22 different host computers and does not require large buffers with software restrictions, it offers versatile backup and dense storage to systems integrators. The tape runs at 75 in./s.

Units are available now. Prices were unavailable at press time.

Telex Computer Products Inc., 6422 E. 41st St., Tulsa, Okla. 74135.
Phone (918) 627-1111 [Circle 372]

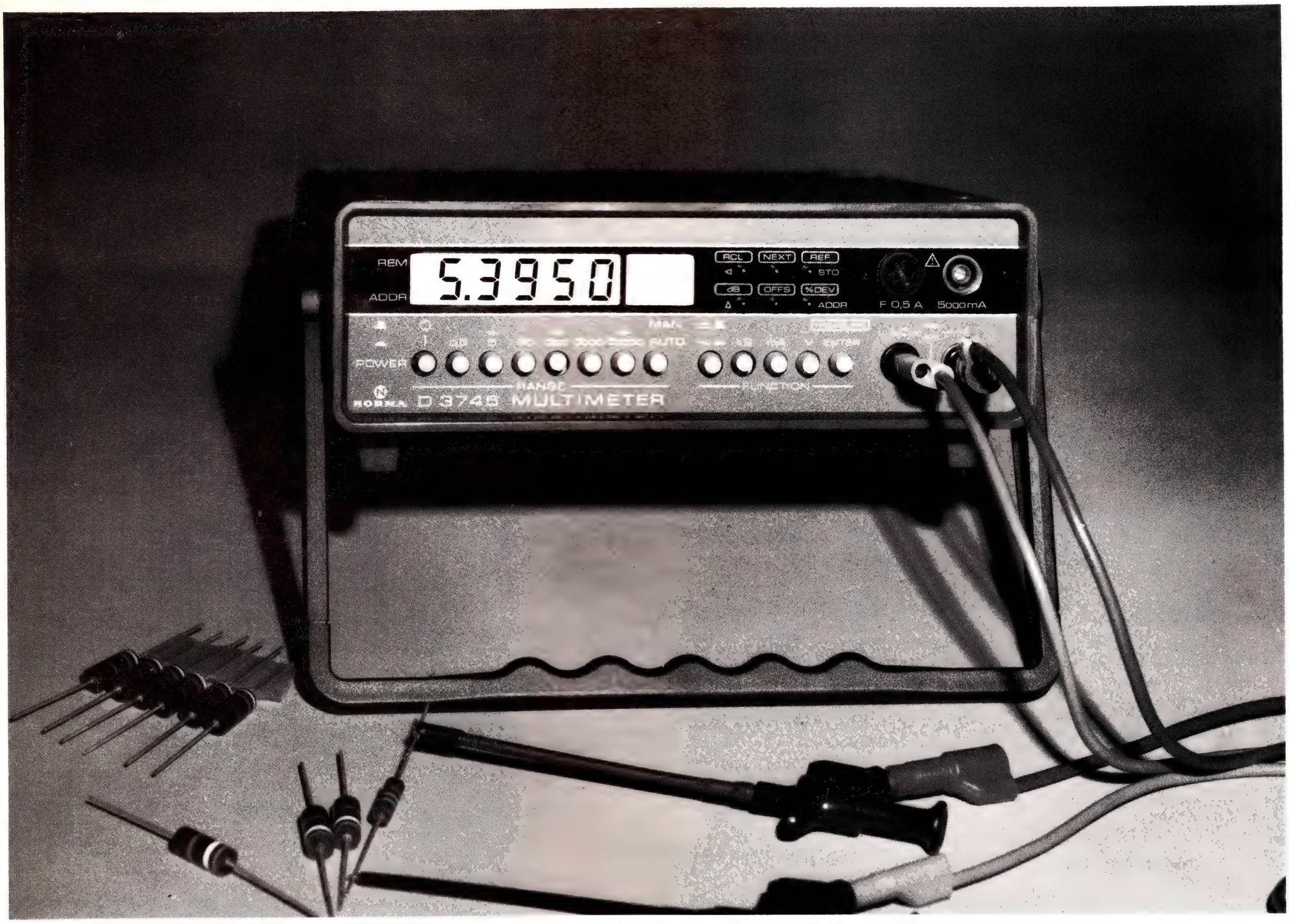
BOARD EASES DESIGN OF MULTIBUS II GEAR

The iSBC LNK/001 board speeds design time for Multibus II products by linking Multibus I and II systems. Manufacturers who have invested in Multibus I hardware and software can apply these investments to the design of Multibus II boards, systems, and software. Multibus II systems find most of their applications in real-time industrial systems, for such tasks as I/O, memory, peripherals control, and graphics.

Key elements of the iSBC LNK/001 board are memory mapping and interrupt conversion. The board contains a 128-K-byte dual-port memory, part of a total of 16 megabytes of Multibus I memory that is mapped into the 4 gigabytes of Multibus II memory. The dual-port memory gives an intelligent Multibus II board access to information in a Multibus I system without having to arbitrate for the Multibus I system bus.

Shipments of the board will begin in September. The unit price is $1,225.

Intel Corp., Literature Dept. W242, 3065 Bowers Ave., Santa Clara, Calif. 95051.
Phone (408) 987-8080 [Circle 364]



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D 2230	20 nA-200 mA	200 mV-600 V	2 kΩ-2 MΩ
	2 mA-200 mA	200 mV-600 V	
D 3210	200 µA-20 A	200 mV-2000 V	200 Ω-20 MΩ
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	200 µA-20 A	200 mV-2000 V	
DA 3232	200 µA-20 A	200 mV-(2000 V)	200 Ω-20 MΩ
	200 µA-20 A	200 mV-(2000 V)	
D 3745 IEEE 488	0.5 mA-5 A	0.5 V-1000 V	500 Ω-50 MΩ
	0.5 mA-5 A	0.5 V-1000 V	
D 4025 IEEE 488	250 µA-2.5 A	250 mV-1000 V	25 Ω-25 MΩ
	250 µA-2.5 A	250 mV-1000 V	
D 4045 IEC 625	250 µA-2.5 A	250 mV-1000 V	25 Ω-25 MΩ
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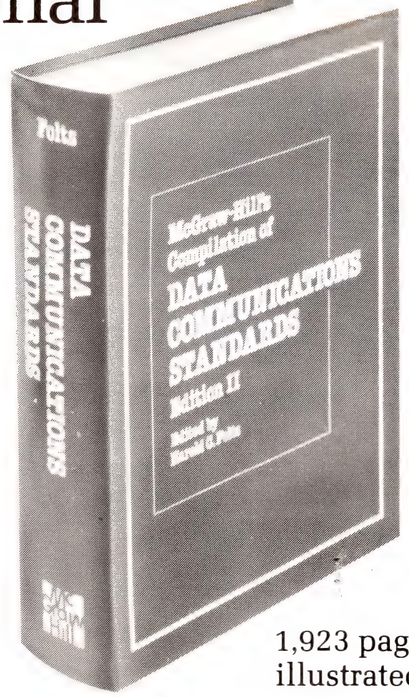
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MEMORY CARDS COST $691 PER MEGABYTE

At $691 per megabyte for a three-board, 7-megabyte configuration, the 32-bit DRAM-3 series of VMEbus memory boards offer a low-cost solution for applications such as image processing or machine vision, with their large local-memory requirements. At the same time, board count is minimized—another critical factor in these applications—because the master board contains all bus-interface and processing logic for 32-bit address and data paths, freeing board space on a slave board for 3 or 6 megabytes of dynamic RAM.

DRAM-3 boards are fast—typical write-access time is 65 ns and read-access time is 210 ns—suiting them for number-crunching or applications that require large RAM disks.

The price quoted above is for 100-unit quantities, deliverable in 30 days. According to this price schedule, a two-board, 4-megabyte configuration sells for $750 per megabyte. A 6-megabyte slave board will be released in the fourth quarter.

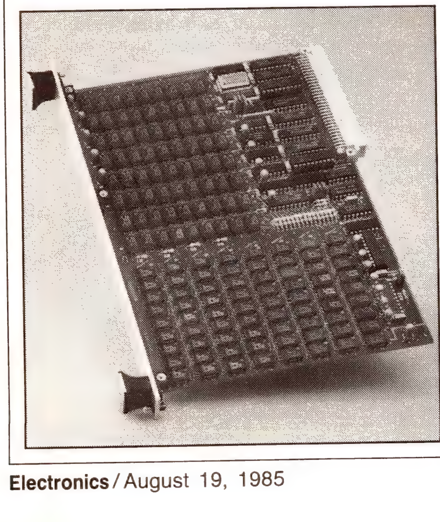
Force Computers Inc., 727 University Ave.,
Los Gatos, Calif. 95030.
Phone (408) 354-3410 [Circle 365]

DOUBLE-HIGH CARD HOLDS 4 MEGABYTES

The VME 48600 dynamic RAM module features up to 4 megabytes on a single double-high Eurocard, using 256-K components. The memory array is organized as 16 banks of 9 bits each paired to permit either 8- or 16-bit transfers per access.

The memory module is asynchronous with the VMEbus. Other features include selectable byte parity and distributed, transparent refresh.

Two models are available: the 452-48602H with a 1-megabyte capacity (using 64-K RAMs) which sells for $1,887 in quantities of one to five, and the 4-megabyte 452-48604B (using 256-K RAMs), which sells for $6,269 for the same quantities. Both memory boards are available immediately from stock.

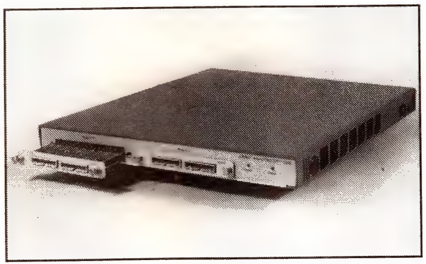


BICC-Vero Electronics Inc., 40 Lindeman
Dr., Trumbull, Conn. 06611.
Phone (203) 372-0038 [Circle 366]

PLUG-INS INCREASE ANALYZER'S ABILITIES

Primarily a 200-MHz logic analyzer, the MFI-1000 has room for two plug-in modules that let it also act as a pattern generator, digital oscilloscope, arbitrary waveform generator, continuity tester, an EPROM programmer, or an EPROM emulator.

As a logic analyzer, the unit features 62 inputs with microprocessor disassembly probes, up to 8,196 samples per channel, four external clocks and eight clock qualifiers, 14 levels of if-then-else triggering, and a separate glitch memory. Up to four MFI-1000s can be stacked to boost the time-synchronized channel capacity to 128 inputs or outputs.



By coupling the system with an IBM Corp. Personal Computer, the MFI-1000 gets the additional capabilities of automatic operation, more memory, and post acquisition and data analysis. Control software is provided on a 5¼-in. disk.

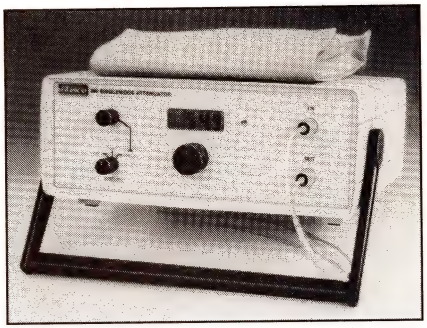
Complete systems sell for $3,820.

Array Analysis Inc., 145 Langmuir Lab,
Brown Rd., Ithaca, N. Y. 14850.
Phone (607) 257-6800 [Circle 387]

ATTENUATOR HANDLES SINGLE-MODE FIBERS

Optimized for single-mode optical margin measurements and fiber-loss simulations in the field or laboratory, the model 200 optical attenuator uses antireflective coatings and expanded-beam technology to hold a ±0.5-dB calibration accuracy over a spectral range of 1,260 to 1,580 nm. Attenuation can be varied continuously from insertion loss—typically less than 4 dB—to over 55 dB.

The unit's digital LCD reads directly to 0.1 dB, eliminating the guesswork of graduated dials. Two display modes provide measurement flexibility. An absolute mode displays the total attenuation level selected; a relative mode displays the difference between a level preset by the user and the actual attenuation.



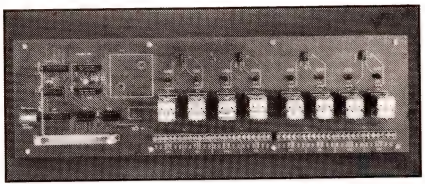
Priced at $2,990, the system can be delivered in 8 to 10 weeks.

Intelco, 282 Central St., West Acton, Mass.
01720. Phone (617) 264-4485 [Circle 388]

CARD GIVES IBM PC CONTROL OF RELAYS

With the MEM-8 card, an addition to the Metrabus line of interface boards, IBM Corp. Personal Computers, PC/XTs, or PC ATs can control up to 512 electromechanical relays. The board contains eight double-pole, double-throw relays with 5-A contacts, and all the circuitry to connect with the Metrabus system.

Included are a parallel bus, I/O-interface system for the PCs that consists of a driver card in one of the expansion slots in the PC, a 50-conductor communications cable, and Metrabus interface boards such as the MEM-8. The user programs the Metrabus system simply by using the INP and OUT commands in Basic or with equivalent commands in other languages.



The MEM-8 card, which sells for $295, is available from stock.

Metrabyte Corp., 254 Tosca Dr., Stoughton, Mass. 02072.
Phone (617) 344-1990 [Circle 389]

HALF-SIZE CARDS FOR IBM PC ADD I/O LINES

Three boards for scientific and industrial tasks fit into the half-height slots of the IBM Corp. Personal Computer, PC/XT, or PC AT to provide analog inputs, analog outputs, and digital I/O.

The DT2814 data-acquisition card, which sells for $299, has 16 single-ended inputs, sample-and-hold amplifier, 12-bit 25-μs analog-to-digital converter, and complete timing and control logic for connection to the IBM PC's bus. The $399 DT2815 is an eight-channel 12-bit digital-to-analog-converter card that

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Gate Array Update

Gate arrays are central to application-specific ICs. Because they provide fast turnaround at a cost-effective price, they're the most popular devices for implementing semicustom logic designs. This report will discuss the latest gate array technology, including increases in speed and size, plus the range of products and services available. Latest tools for designers to implement gate array designs will also be covered.

The Market
According to industry estimates, this market will grow from $635 million this year to $1.4 billion by 1990.

Target Readers
Design engineers, senior engineers, engineering managers, and executives of companies that manufacture electronic systems. IC designers in semiconductor companies, silicon foundries, and those in-house semiconductor facilities of system houses.

Issue Date: September 23, 1985

Closing for Advertising: September 2, 1985

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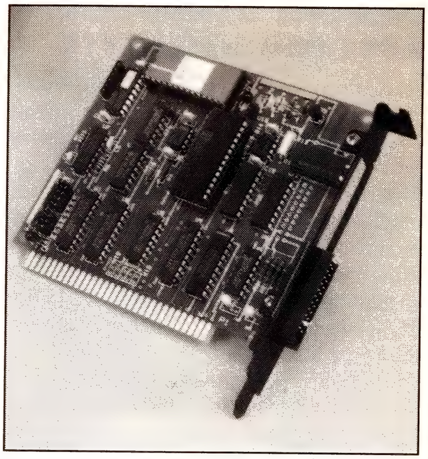

generates analog outputs of ±5-V, 0- to 5-V, or 4- to 20-mA current loop. The user selects outputs by jumpers.

The DT2817 provides 32 lines of digital I/O configured as four ports of eight lines. The ports are bidirectional for accepting or sending out data. With the DT2817's internal control register, the user can configure the direction of the I/O lines.

The DT2817, which sells for $199, is available from stock.

Data Translation, 100 Locke Dr., Marlboro, Mass. 01752.
Phone (617) 481-3700 [Circle 390]

HYBRID REPLACES MECHANICAL RELAYS

Designed to replace electromechanical relays in power-control applications of up to 10 A, the M33 high-power dc-switching and power-control hybrid can be supplied with integrated short-circuit and current-overload protection as optional features.

Short-circuit protection prevents damage in cases of switching into a dead short or shorting the power controller while under load. In either case, the unit will sense the short-circuit condition and initiate shut down in less than 1 μs.

The part will also sense current overload and prevent damage from thermal runaway because of excessive load current or ambient operating temperatures. These integrated protection features not only provide self-protection for the device, but also allow the unit to act as a circuit-breaker, preventing secondary system failures.

The M33's output is rated at 10 A at 80 V dc with on-state resistances as low as 0.15 Ω. The standard version sells for $97 each in lots of 100 pieces. The model with the protection circuitry, the M33S, sells for $108 each in like quantities. Delivery takes 14 weeks.

Teledyne Solid State, 12525 Daphne Ave., Hawthorne, Calif. 90250.
Phone (213) 777-0077 [Circle 376]

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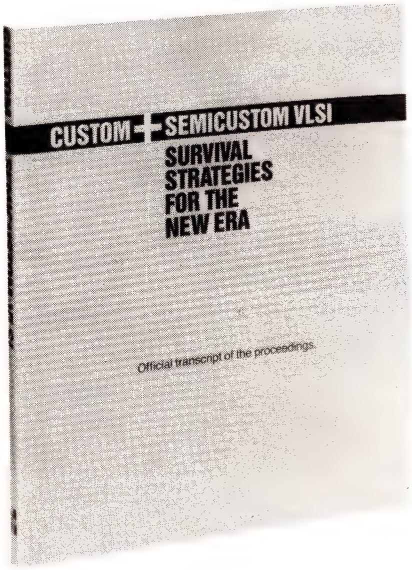

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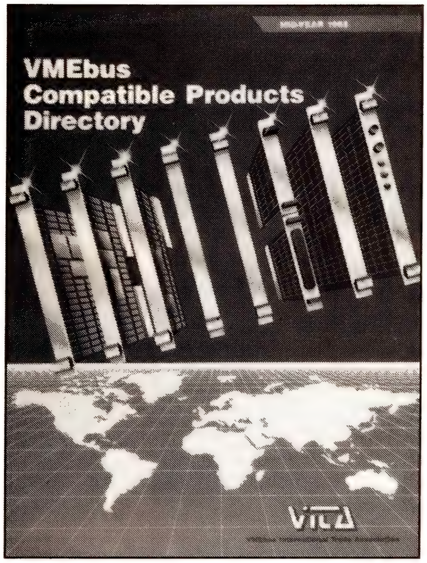


MIDYEAR 1985

VMEbus
Compatible Products
Directory

VITA

VMEBUS. The VMEbus International Trade Association (VITA) has published the midyear 1985 edition of the *VMEbus Compatible Products Directory.* This year's directory features microcomputer boards, systems and subsystems, software, accessories, and hardware packaging—more than 1,000 products. It also lists over 200 VMEbus manufacturers. For a free copy, write on company letterhead to VITA, Department P, 10229 N. Scottsdale Rd., Suite E, Scottsdale, Ariz. 85253, or call (602) 951-8866. [Circle reader service number 421]

EEPROMs. Xicor Inc. is publishing its first data book in a 7-by-9-in. format. The 464-page book covers the company's Novram (nonvolatile static RAM) line, serial I/O devices, EEPROMs and a digitally controlled potentiometer, plus application notes and packaging information. Copies are available from Xicor at no charge. Call (408) 946-6920 or write to 851 Buckeye Court, Milpitas, Calif. 95035. [Circle 422]

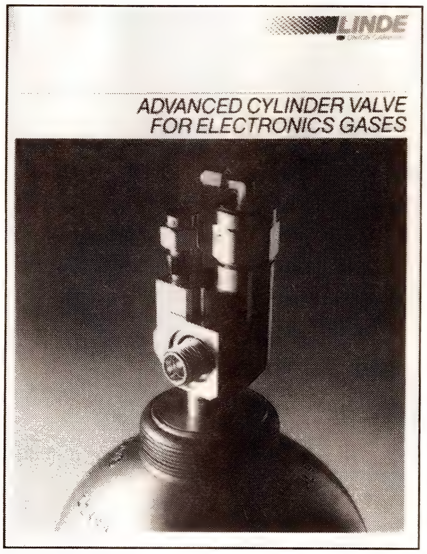
STANDARD. The Electronic Industries Association has published Jedec Standard No. 24, "Power Mosfets." Priced at $18, JESD-24 contains a listing of terms, definitions, and letter symbols; a description of how industry-type designations are assigned to power transistors; electrical verification tests; thermal characteristics; and a user's guide. Copies are available through the EIA, Standard Sales Office, 2001 Eye St., N. W., Washington, D. C. 20006. Phone (202) 457-4966. [Circle 425]

MOS. Gould AMI Semiconductors has begun distribution of its "1985 MOS Product Catalog." This updated edition indexes products by part number, function, and equivalents to parts from other manufacturers. It discusses gate arrays and standard cells, communications products, consumer products, and memories. Three sections deal with microprocessors and microcomputers. New items include the S7720 digital signal processor and the S35213 Bell 212A single-chip modem in communications, and the S6516 2,048-by-8-bit CMOS RAM. Request a free copy from the company at 3800 Homestead Rd., Santa Clara, Calif. 95051. Phone (408) 246-0330. [Circle 423]

TECHNALYSIS. A free quarterly newsletter from Honeywell Technalysis gives quick reports from ongoing research programs at the company's laboratories. A recent issue describes very large-scale-integration research carried out in gallium arsenide, fiber-optic pressure sensors, air-flow detection, and other emerging technologies. The product-oriented newsletter gives lead-time-to-market schedules for the research it presents. To receive Technology News, call (212) 512-0614, or write to Honeywell Technalysis, 380 Madison Ave., New York, N. Y. 10017. [Circle 424]

WORK STATION. This brochure introduces DIR Board-Maker, a turnkey work station for prototyping circuit boards that includes software, a four-function table (mill, drill, rout, plot) with spindle and plotting head, a console, and an IBM Corp. Personal Computer or PC/XT. For a free copy, write to DIR Advanced Technologies Inc., 624 E. Evelyn Ave., Sunnyvale, Calif. 94086; or call (408) 733-7459. [Circle 430]

HAZARDOUS GASES. A remotely controlled cylinder valve, recommended for the control of highly reactive and toxic electronics gases, is described in this free four-page brochure. The valve's maximum operating pressure is 3,000 lb/in.^{2} gage, and delivery pressure goes as low as 105 lb/in.^{2} gage. The valve has a flow restrictor that limits flow rate in the event of a downstream leak. For a copy, write to Union Carbide Corp., Linde Division, Department R2654, 39 Old Ridgebury Rd., Danbury, Conn. 06817 and request form L5968. [Circle 426]



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AI. Automation Intelligence Inc. is distributing three brochures describing its Opti-Vision intelligent vision systems, the Producer series of intelligent controls, and Engineering Services. Opti-Vision offers 64 gray-scale levels and up to 10 images/s throughput in 512-by-240-pixel formats. The Producer family controls machining operations from a 2-axis punch press through a 5-axis robot or 12-axis profile milling machine. Engineering Services provides field support for both products. Request these by calling (305) 843-7030 or by writing to the company at 1200 W. Colonial Dr., Orlando, Fla. 32804. [Circle 427]

COMPONENTS. A 24-page short-form catalog from the Potter & Brumfield Division of AMF Inc. lists solid-state relays and I/O modules, time-delay relays, relays that meet military specifications, impulse and latching relays, and other components. Brief specifications are given for each series. Free copies can be obtained by calling Marketing Communications at (812) 386-1000 or writing to the company at 200 S. Richland Creek Dr., Princeton, Ind. 47671. [Circle 428]

GLITCHES. A four-page application note, titled "Deglitched DACs Improve Vector-Stroke Displays," targets designers of drive circuitry for the deflection amplifier of a vector-stroke CRT display. A glitch is a short-duration output transient visible on the screen. The note illustrates and describes a typical single-package deglitched digital-to-analog converter. Copies of the application note are available from the Marketing Department, ILC Data Device Corp., 105 Wilbur Pl., Bohemia, N. Y. 11716; phone (516) 567-5600. [Circle 429]

LEADS. Bent leads on dual in-line packages can shut down an auto-insertion line, this manufacturer of lead-inspection equipment points out in a four-page brochure. MCT Synerception has arrived at a preinsertion, proprietary 100% inspection system that the manufacturer says will result in zero defective parts on the pc board. The brochure describing the LS 2300 lead-scanning systems is free from Micro Component Technology Inc., 3850 N. Victoria St., P. O. Box 64013, St. Paul, Minn. 55164; phone (612) 482-5100. [Circle 431]

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AT&T TO LAY OFF 1,000 WORKERS

AT&T Co. plans to lay off 1,000 more assembly workers at its Shreveport, La., plant because of "an unexpected softening in the telecommunications market." The layoffs came on the heels of a two-pronged announcement in July, when AT&T let go 875 telephone production workers at Shreveport and said it would move its consumer telephone manufacturing operations to Singapore in early 1986.

Of the newly laid-off workers, 400 had been involved in manufacturing such business products as AT&T's Merlin telephone systems and its systems 75 and 85 private branch exchanges, 350 built home telephones, and 250 made components for those products. "We forecast sales of these products two years in advance, but obviously we have to revise those forecasts on a monthly basis," a representative says. AT&T said heavy competition and sufficient inventories of parts and systems spurred the layoff decision.

SHARP RENEWS WAFERSCALE DEAL

Sharp Corp., Osaka, Japan, and Waferscale Integration Inc., Fremont, Calif., have extended their technology and production agreement covering a high-performance CMOS cell library for application-specific integrated circuits. Sharp makes its 1.6-µm CMOS technology available to WSI in exchange for use of the cell library.

AMD EXTENDS AUSTERITY PLANS

Still feeling the effects of the semiconductor market recession, Advanced Micro Devices Inc., Sunnyvale, Calif., will extend its austerity plans through December. The plans, started in June, were supposed to last through September. Though managerial and professional personnel are resuming a five-day work week, they will take a 10% pay cut; executives lose 15%. Other employees remain on the four-day schedule with a 15% pay cut, but no layoffs are planned. Despite the cuts, AMD reports that the employee attrition rate is lower than last year, an indication of the depressed job market in the industry.

GTE SPRINT TO CUT 600 EMPLOYEES

GTE Sprint, the long-distance telecommunications subsidiary of GTE Corp., Stamford, Conn., plans to cut about 600 employees from its 7,000-person work force in the next month. GTE Sprint president Don Prigmore says the action "responds to the continuing need to be cost effective." He adds that the reduction comes after "a substantial addition to network capacity" by the company.

LEHIGH SETS UP HIGH-TECH CENTER

Lehigh University, Bethlehem, Pa., will establish a Center for Innovation Management Studies under a $355,000 grant from the National Science Foundation. It will explore techniques to improve industrial applications of new technology.

BELLSOUTH BLOCKS MCI CELLULAR DEAL

MCI Communications Corp. and Bellsouth, the regional telephone company, are bickering over who gets MCI's cellular telephone and paging subsidiary, MCI Airsignal. Now Bellsouth has blocked MCI's latest effort to sell it. Last week, MCI agreed to sell Airsignal to McCaw Communications Inc., Bellevue, Wash., for about $120 million. That followed the aborted sale of the unit two weeks earlier to Mobile Communications Corp. of America after MCI discovered that Bellsouth was a Mobile partner. Bellsouth has gone to federal court to force MCI to honor the initial sale.

GE CALMA UNIT ADDING R&D STAFF

Calma Co., a subsidiary of General Electric Co., plans to hire more than 200 engineers for its research and development operations in Milpitas and San Diego, Calif., and in Austin, Texas. Calma, which makes equipment for computer-aided engineering, design, and manufacturing, said the hirings will be made by the first quarter of 1986; the additions will increase its R&D staff by 50% to support increased software and hardware development.

EAGLE SEEKS NEW CAPITAL

Eagle Computer Inc., Garden Grove, Calif., is looking to raise working capital through a new stock offering and has called a special meeting of shareholders to approve its plan. It wants to issue a new class of preferred stock and to increase the number of authorized common shares of the company. Eagle said it needs the equity to launch a new product and to have the flexibility to acquire new technology.

HARRIS PROFIT DROPS IN QUARTER

Reflecting weakness in its operations ranging from semiconductors to computers, Harris Corp., Melbourne, Fla., said last week its earnings in its fiscal fourth quarter dropped 33%, to $16.1 million, on a 4% gain in sales. For fiscal 1985, which ended June 30, Harris posted earnings of $80.3 million (compared with $80.4 million last year). Sales in fiscal 1985 rose 14% to $2.28 billion.

Its semiconductor operation, which was profitable last year, suffered a loss in the latest quarter. Executives say they see no signs of an upturn in the semiconductor and data-processing markets. "As a result, we expect earnings in the first half [of fiscal 1986] will be significantly lower than the first half of fiscal 1985," the company reports.

CHANGES SEEN IN TERMINAL MARKET

The U. S. market for display terminals is undergoing dramatic changes that include intense price competition and maximum efficiency in distribution channels, according to a new study by Advanced Resources Development, a market research company in Medfield, Mass. Unit shipments of display terminals will increase an average of 16.4% annually between 1985 and 1989, ARD projects, but revenue from these shipments will increase by only 7.1% annually in that time.

APPLE SEES HELP ON WALL STREET

A trio of software packages may help sell "several hundred thousand" Macintosh computers to the investment community, believes Apple Computer Inc. president John Sculley. With Macmonitor, Macstock, and Macinvestor, Macintosh users will be able to receive real-time stock data from all major New York exchanges.

The software, from Bonneville Telecommunications Co., a subsidiary of Bonneville International Corp., Salt Lake City, uses Bonneville's satellite and proprietary FM subcarrier broadcaster and transceiver. Macmonitor is available now for $225. The monthly charge for a one-year data service contract to anywhere in the U. S. is $145. Bonneville will also sell Macintosh computers, accessories, and software. A similar package is already available to users of IBM Corp. Personal Computers.

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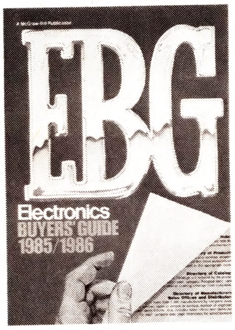

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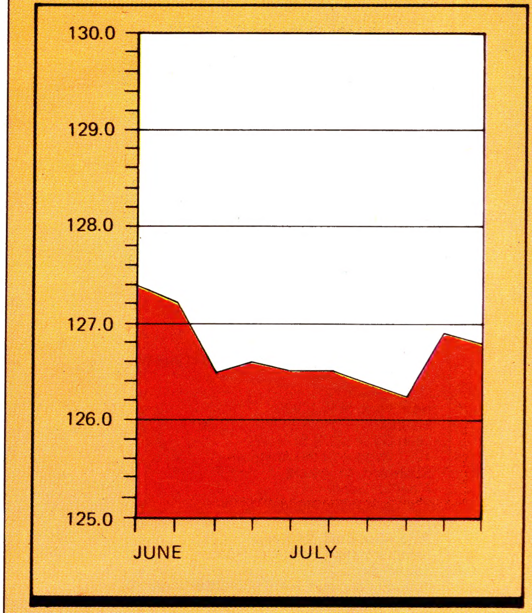
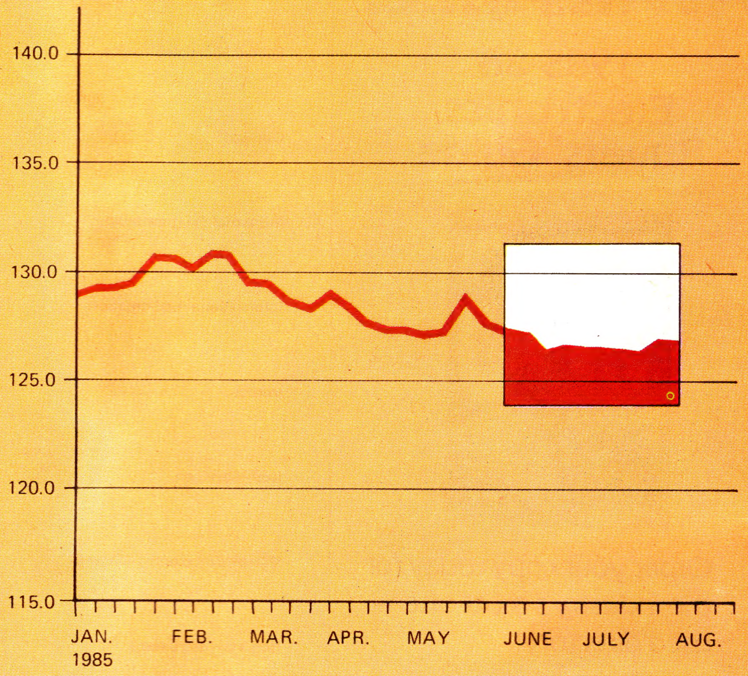
ELECTRONICS INDEX



THIS WEEK = 126.8
LAST WEEK = 126.9
YEAR AGO = 130.6
1982 = 100.0



The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. ELECTRONICS INDUSTRY EMPLOYMENT

Production workers (thousands)	June 1985	May 1985	June 1984
Office and computing machines	184.7	184.8	213.1
Communications equipment	296.1	295.4	280.4
Radio and TV receiving equipment	57.4	57.3	63.9
Components	373.6	378.1	410.0

U. S. GENERAL ECONOMIC INDICATORS

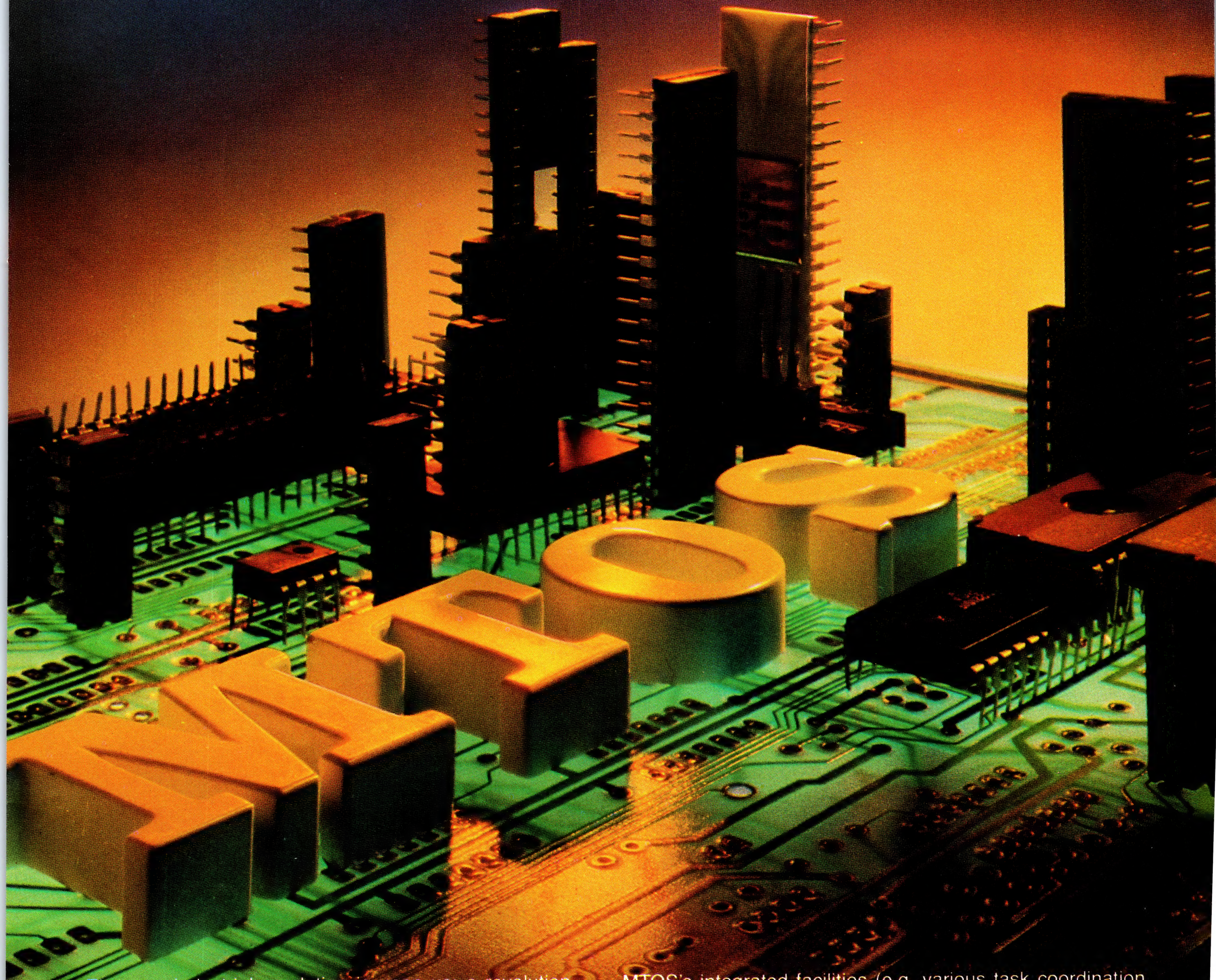
	June 1985	May 1985	June 1984
Average prime rate (%)	9.78	10.31	12.60
Retail sales ($ billions)	113.935	114.808	109.085
Unemployment rate (%)	7.2	7.2	7.1

Failing to keep pace with last week's gains, the *Electronics* Index slipped a fraction of a point in the latest week. The drop comes on a 0.4% decline in employment in June in the U. S. electronics industry. Employment is one of the factors used to compute the Index. Though nearly all electronics-industry economic indicators fell during the past year, employment has been the hardest hit. Total employment among U. S. electronics-industry companies has fallen about 6% from levels of a year ago.

With labor-force declines of 13.3%, the computer industry registered the most drastic year-to-year drop in employee levels. Manufacturers of radio and television equipment rank second, with a 10.2% drop in the number of production workers over the past year. Not surprisingly, component manufacturers, whose industry has been hard hit all year, reported a 9% cut in worker payrolls from a year ago. The only industry that managed to increase its hiring was the communications-equipment sector. Worker payrolls here increased 5.5% in June 1985 over June 1984 levels.

On the general economic front, the continuing decline in interest rates has presaged a revival in the economy for some time now. Yet June retail sales were down 0.8%, housing starts scored only modest gains, and domestic auto sales are stagnant. Nonetheless, U. S. manufacturers can take heart that with interest rates in July down 3.5 percentage points from a year ago, the electronics industry's fortunes should pick up.

Real-Time Operating Systems for the New Industrial Revolution



The new industrial revolution is upon us; a revolution driven by microprocessor technology.

MTOS real-time operating systems are significant components of micro-based systems such as avionics, digital switches, CAD/CAM, medical imaging, process control, robotic controllers and weather radar.

MTOS plays a significant role in this revolution for many reasons ... MTOS features handle the widest spectrum of applications in the field, ranging from the gigantic to the very small. Built-in flexibility and richness are MTOS strong points. MTOS's integrated facilities (e.g. various task coordination methods, memory and time management, interrupt-driven input/output) simplify the development process and allow the product to run faster. Moreover, MTOS is often the ONLY ALTERNATIVE. It is the ONLY genuine multi-processor system for commonly used microprocessor families.

For more information, contact Mr. Bernard Mushinsky, Industrial Programming, Inc., 100 Jericho Quadrangle, Jericho, NY 11753, (800) 228-MTOS or (516) 938-6600.

The Standard Setter In Operating Systems Software

ipi **Industrial Programming Inc.**

Circle 901 on reader service card

There's Room in One LCD Module for the Entire Globe.

–It Displays 2,000 Characters on a Large Screen–

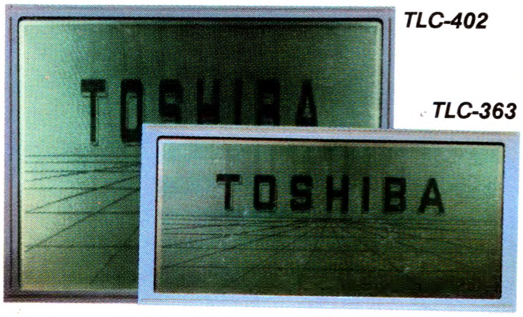
Simulated pic

New LCD modules from TOSHIBA give you 640 × 200 dot displays plus your choice of display area: virtually the size of an ordinary magazine or half that size.

The large display area puts a lot of information on view – either module can give you an array of 80 characters × 25 lines. Yet TOSHIBA technology cuts bulk and power consumption to the bone. These slim LCD modules are battery-powered, and they are compatible with current CRT displays without changing software.

All these features add up to portability. Versatility. Usability. These LCD modules are ideal as displays for portable word processors, personal computers, POS terminals and other display terminals.

Ask us. TOSHIBA is there when it comes to the technology you need in LCD components.



Specifications

		TLC-402	TLC-363
Display			
Number of Characters		80×25 (2,000 characters)	80×25 (2,000 characters)
Dot Format		8×8, alpha-numeric	8×8, alpha-numeric
Overall Dimensions (W×H×D)		274.8×240.6×15.0 mm	275.0×126.0×15.0 mm
Maximum Ratings			
Storage Temperature		–20 – 70°C	–20 – 70°C
Operating Temperature		0 – 50°C	0 – 50°C
Supply Voltage	V_{DD}	7 V	7 V
	V_{DD}-V_{EE}	18 V	18 V
Input Voltage		$0 \leq V_{IN} \leq V_{DD}$	$V_{SS} \leq V_{IN} \leq V_{DD}$
Recommended Operating Conditions			
Supply Voltage	V_{DD}	5 ±0.25 V	5 ±0.25 V
	V_{EE}	–13 V Max.	–13 V Max.
Input Voltage	High	4.0 V Min.	4.0 V Min.
	Low	0.5 V Max.	0.5 V Max.
Typical Characteristics (25°C)			
Response Time	Turn ON	300 ms	300 ms
	Turn OFF	300 ms	300 ms
Contrast Ratio		5	5
Viewing Angle		15 – 35 degrees	15 – 35 degrees

Design and specifications are subject to change without notice.

TOSHIBA

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